EXHIBIT 1

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
SHERMAN DIVISION

MOBILITY WORKX, LLC, **Plaintiff,** **v.** **CELLCO PARTNERSHIP D/B/A VERIZON WIRELESS,** **Defendant.**	**Civil Action No.: 4:17-CV-00872-ALM** **JURY TRIAL DEMANDED**

<u>EXPERT REPORT OF JAMES A. PROCTOR, JR, M.S.E.E. REGARDING INVALIDITY OF THE ASSERTED CLAIMS</u>

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I. INTRODUCTION

1. I have been retained by counsel for Cellco Partnership d/b/a Verizon Wireless ("Verizon" or "Defendant") to serve as an independent expert in this litigation and to provide opinions and testimony about United States Patent Nos. 8,213,417 ("the '417 Patent") and 7,231,330 ("the '330 Patent") (collectively, "the Asserted Patents" or "Patents-in-Suit"). It is my understanding that United States Patent No. 7,697,508 ("the '508 Patent") is no longer in the case because Plaintiff has represented that it is no longer asserting the '508 Patent.

2. I understand that Verizon is the Defendant in Civil Action No. 4:17-cv-00872-ALM. I understand that Mobility Workx, LLC ("Mobility Workx") is the Plaintiff. I also understand that Mobility Workx alleges that Verizon infringe claims 1, 4, and 7 of the '417 Patent and claims 1, 3, and 4 of the '330 Patent (collectively "the Asserted Claims").

3. This Report is based on information currently available to me. I reserve the right to further supplement my analysis in this Report in response to any reports prepared on behalf of Mobility Workx. I also reserve the right to amend or supplement my opinions based on further discovery and information provided in this case.

4. All of the opinions stated herein are based on my own personal knowledge and professional judgment and my analysis of the materials and information I considered in preparing this Report, which are mentioned herein. If called as an expert witness in this case, I anticipate that my testimony will concern my opinions regarding invalidity discussed herein, as well as a tutorial on technology relevant to the issues in this case. I reserve the right to create any additional summaries, tutorials, demonstrations, charts, drawings, tables, and/or animations that may be appropriate to supplement and demonstrate my opinions at trial.

5. I am being compensated for my time at the rate of $400/hour. I am being separately reimbursed for any out-of-pocket expenses. My compensation does not depend in any way on the

outcome of this litigation or the particular testimony or opinions that I express, and I have no other interest in this litigation or the parties thereto.

II. QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

6. I am qualified by education and experience to testify as an expert in the field of telecommunications. Attached as Exhibit 1 to this declaration is a copy of my curriculum vitae detailing my education and experience. Additionally, the following overview of my background pertains to my qualifications for providing expert testimony in this matter.

7. I have worked as an engineer and entrepreneur in the field of wireless communications for over 25 years, and have been involved with various aspects of wireless communications for the duration of my career.

8. I currently am named inventor or co-inventor on more than 270 issued U.S. patents, and more than 700 international patent publications in total. A number of these patents and patent applications are related to the subject matter of the ’417 and ’330 Patents. As will be discussed in further detail below, the subject of the ’417 Patent relates to aspects of maintaining network layer communications with a mobile node as it moves from one network access point or base station coverage area to another, referred to as a handoff. The subject of the ’330 Patent relates to emulating mobile networks with RF and network impairments.

9. As an initial example of my relevant qualifications, a selection of my issued patents pertaining to aspects of cellular networks, handoff, registration, network routing, and/or resource allocation in a wireless network (and to the ’417 and ’330 Patents) are listed in the following table. The listed patents are either prior art, or are contemporaneous to the claimed priority date of the ’417 and/or ’330 Patents.

U.S. Pat. Num.	Title	Priority Date
6,542,481	Dynamic bandwidth allocation for multiple access communication using session queues	1/6/1998
6,973,140	Maximizing data rate by adjusting codes and code rates in CDMA system	3/5/1999
8,321,542	Wireless channel allocation in a base station processor	5/5/2000
6,937,562	Application specific traffic optimization in a wireless link	2/5/2001
6,941,152	Wireless subscriber network registration system for configurable services	4/24/2001
9,867,101	Method and apparatus for allowing soft handoff of a CDMA reverse link utilizing an orthogonal channel structure	7/19/2000
6,545,990	Method and apparatus for a spectrally compliant cellular communication system	12/20/1999
7,113,786	Antenna adaptation to manage the active set to manipulate soft hand-off regions	3/8/2002
8,498,234	Wireless local area network repeater	6/21/2002
6,888,807	Applying session services based on packet flows	6/10/2002
9,456,376	Subscriber-controlled registration technique in a CDMA system	4/28/1999

10. For these reasons, and because of my technical experience and training as outlined below, I am qualified to offer technical opinions regarding the validity/invalidity of the ’417 and ’330 Patents.

11. A substantial portion of my work has been focused on wireless communication systems and products. For example, my educational background includes a BSEE from the University of Florida (1991) and MSEE from the Georgia Institute of Technology (1992) focusing on digital signal processing.

12. From 1986 to 1991, while at the University of Florida, I interned with Harris Corporation in various roles including mechanical design, software development, and digital design. From 1991 to 1992, while at Georgia Institute of Technology, I worked at the Georgia

Tech Research Institute (GTRI) as a graduate research assistant, performing software development on classified government programs.

13. From 1993 to 1995, while working for Harris Corporation, I designed various cellular communications systems for voice, data, and tracking/location. Many of the systems I designed utilized advanced communications technologies, such as those utilized in the then-developing and future telecommunication standards (such as IS-95, W-CDMA, and aspects of LTE).

14. From 1995 to 1998, I worked at Spectrian in advanced development and technical marketing. At Spectrian, I interfaced with Nortel's and Qualcomm's product management and performed advanced technology development and systems analysis. In this role, I designed IS-95 CDMA and GSM base station power amplifiers and control electronics, and received several patents associated with advanced linearization techniques for the reduction of transmitted distortion.

15. From 1998 to 2002, I served as the Director of Strategic and Technical Marketing at Tantivy Communications, a venture capital-funded 3G cellular data and chip set company. At Tantivy, I helped to architect and standardize the I-CDMA Spread Spectrum Systems Air Interface Standard (T1P1.4). I also developed both subscriber units and base stations that complied with the standard. The base stations utilized various IP protocols, and interfaced with the wire line network utilizing IP over Ethernet. Additionally, I participated in and provided technical contributions to 3GPP/3GPP2 standardization efforts related to the development of CDMA2000 and 1xEV-DO. This work resulted in my being named as a co-inventor on more than 150 pending or issued U.S. patents or applications.

16. From 2002 to 2007, as co-founder of WiDeFi, Inc., I served in various roles including President, CEO, CTO, and board member. As the CEO, my responsibilities included advanced development of platform technologies. I was co-inventor of wireless technology components, including a frequency translating TDD repeater, a same frequency repeater architecture for TDD/FDD-based systems, and physical layer multi-stream MIMO repeater technology. WiDeFi invented and provided wireless home networking products based on WiFi and cellular technologies. While at WiDeFi, I was a named inventor on over 25 issued U.S. patents or patent applications.

17. From 2007 to 2009, I consulted as a principal engineer for Qualcomm Inc. as part of the acquisition of WiDeFi's technology. While at Qualcomm, I worked with its corporate R&D division and developed consumer 3G and 4G cellular coverage enhancement systems utilizing WiDeFi's baseband interference cancellation technologies. My responsibilities included working with international cellular operators on product requirements, detailed W-CDMA simulations, Long Term Evolution ("LTE") systems analysis, and participation in prototype product realization. I am currently a named inventor on roughly 45 issued U.S. patents or patent applications assigned to Qualcomm.

18. From 2010 to the present, I have served as managing director and co-founder of Proxicom Wireless, LLC, which has developed and continues to develop cloud-based, mobile social networking and mobile payments technology based upon the proximity and location of mobile devices. Proxicom currently holds twelve issued U.S. patents and multiple pending patent applications, of which I am a co-inventor. Significant aspects of Proxicom's technology involve a mobile device's use of short range wireless technologies (802.11, near field communications,

Bluetooth) in combination with cellular data links (3G/WCDMA or 4G/LTE, for example) to facilitate frictionless interactions via a wireless networked central cloud server.

19. Since 2007, I also have been the principal of Proctor Consulting, LLC. In this role, I have been a consultant relating to wired, wireless, and cellular communication and technologies, start-up companies and intellectual property. I also have been involved with numerous patent infringement, patent validity, and patent analysis assignments for public and private companies in the wired, wireless, and cellular networking industries.

20. Additionally, I have worked and consulted for both cellular infrastructure and device focused companies (Spectrian, Qualcomm, Fastback Networks), and defense contractors (Harris Corporation), where I developed covert-tracking and location technologies involving CDMA and smart-antenna technologies.

21. In various of the above-detailed roles, I have been responsible for the development of business plans, product development plans, product development budgets, and product bill of materials estimations. I have been responsible for numerous product development teams, including schedule and costs of the development process at various stages of my career. For example, at Tantivy Communications, I ran a joint development of I-CDMA cellular base stations in Seoul, Korea that were used in a field trial in that country. Additionally, as founder and CEO of WiDeFi, Inc., I was responsible for similar such activities, as required to raise venture capital funding and reporting to the board of directors.

III. MATERIALS CONSIDERED

22. In connection with my analysis in this case thus far, I reviewed and considered a large number of documents, including the Asserted Patents, the prosecution histories of the Asserted Patents (including the file history of the ’508 Patent) and the references cited therein, along with publicly available information, technical and industry documents, and other documents

identified herein. This information, where my consideration of it relates to opinions expressed in this report, is identified through citation and serves as my identification of the facts and documents I considered in forming my opinions. A complete listing of the materials that I have considered in reaching my opinions is attached as Exhibit 2 to this report.

23. I expect that I may refer to the materials specifically mentioned in this report, as well as representative photographs, charts, graphs, schematics, layouts, animations, and/or models at trial and deposition that I may create to support and explain my testimony set forth herein. I may also refer to the parties' technology tutorials dated February 7, 2019. I may also refer to my declaration in support of T-Mobile's Responsive Claim Construction Brief in 4:17-cv-00567-ALM (the "T-Mobile case"),[1] which I incorporate by reference herein. I may also refer to the pending *inter partes* review of the '417 Patent filed by Unified Patents Inc. *See* Petition for *Inter Partes* Review of U.S. Patent No. 8,213,417, *Unified Patents Inc. v. Mobility Workx, LLC*, IPR2018-01150 (filed June 1, 2018). I may also use such materials to explain the alleged inventions, the Asserted Patent or any related Patent, prior art references, relevant technology areas, and/or other matters that may assist the Court and jury in understanding the technology and patents.

24. I reserve the right to rely upon any additional information or materials that may be provided to me or that are relied upon by any of the experts in this case, if called to testify or to give additional opinions regarding this matter.

IV. RELEVANT LEGAL PRINCIPLES

25. In forming my opinions, I have relied upon certain legal principles that counsel for Verizon or counsel in prior matters explained to me. My understanding of these concepts is summarized below.

[1] Mobility asserted the '508 and '417 Patents against T-Mobile in the T-Mobile case.

26. A party asserting invalidity of a U.S. Patent bears the burden of proving invalidity by clear and convincing evidence. Clear and convincing evidence is an evidentiary standard that is higher than a preponderance of the evidence but lower than beyond a reasonable doubt.

A. Anticipation

27. Evaluation of whether a patent claim is "anticipated" is a two-step process. In the first step, the language of the claim is construed as it would be understood by one of ordinary skill in the art at the time of the filing of the patent application. The claim is construed by referring to intrinsic evidence, which includes the claim language, the patent specification, and the prosecution history, as well as extrinsic evidence. The words of patent claims are to be given their ordinary or customary meaning unless the inventor has defined them (acted as their own lexicographer) or used them differently (*i.e.*, in a manner inconsistent with the ordinary and customary meaning). The prosecution history of a patent, and related patents and applications, may limit the interpretation of the claim, especially if the patentee disavowed or disclaimed any claim scope in order to obtain allowance of the claim. I understand that the Court has issued an Order in which it has construed a number of claim terms, and if there are any remaining disputed claim terms, the Court may construe those as well. My testimony is based upon a review of, and application of, the Court's claim constructions. In the absence of a guiding claim construction, I have applied my understanding of how one of ordinary skill in the art would interpret the term at the time of invention at the time of invention.

28. In the second step of the anticipation evaluation, after the language of the patent claims has been construed, comes a comparison of the properly construed claim language to the prior art on a limitation-by-limitation basis.

29. A claimed invention is "anticipated" if each and every limitation of the claim, as properly construed, has been disclosed in a single prior art reference, or has been embodied in a

single prior art device, system, or practice, either explicitly or inherently (i.e., necessarily present or implied), and the claimed arrangement or combination of those limitations was also disclosed either expressly or inherently, in the same prior art reference.

30. I have been informed by counsel that anticipation cannot be established by combining references unless they are expressly incorporated by reference. However, I understand that other references may be used to interpret an anticipating reference by, for example, indicating how one of ordinary skill in the art would understand the anticipating reference, or to demonstrate the inherency of certain disclosure within the reference.

31. In addition, the description provided in the anticipatory prior art must enable a person of ordinary skill in the art in the field of invention to practice the invention without undue experimentation. Prior art patents are presumed to be enabled unless the holder of the asserted patent, who bears the burden of showing prior art is not enabled, shows otherwise. Any showing by the patent holder regarding the enablement of any prior art can be rebutted.

32. I understand that the pre-AIA patent statute applies to the ’417 Patent because of its priority date. I further understand that pre-AIA 35 U.S.C. § 102 provides various ways for a reference to qualify as a prior art reference and that the portions of 35 U.S.C. § 102 relevant in this investigation are (a), (b), (e)(2), and (g)(2), which provide:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, or

* * *

> (e) the invention was described in - . . . . (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent
>
> (g) . . . (2) before such person's invention thereof, the invention was made in this country by another inventor who had not abandoned, suppressed, or concealed it. In determining priority of invention under this subsection, there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other.

33. I understand that in the case of printed publications, such a reference can be prior art only if the reference is proven to be a publication. That is, the reference must have been disseminated or otherwise made available to the extent that a person interested and ordinarily skilled in the art, exercising reasonable diligence, can locate the reference.

34. I understand that in the case of a prior invention, the filing of a patent application is a constructive reduction to practice.

B. Obviousness

35. A patent claim is rendered obvious if the claimed invention would have been obvious to a person of ordinary skill in the art as of the date of invention. A determination of obviousness is made after weighing the following factors: (1) level of ordinary skill in the pertinent art; (2) the scope and content of the prior art; (3) the differences between the prior art as a whole and the claim at issue; and (4) as appropriate, secondary considerations of non-obviousness.

36. In evaluating obviousness, both the prior art and claimed invention should be viewed through the knowledge and understanding of a person of ordinary skill in the art at the time of the invention—one should not use his or her own insight or hindsight in deciding whether a claim is obvious. A claim may be rendered obvious if a person of ordinary skill in the art would understand the claimed invention as a predictable variation of a known reference.

37. An obviousness evaluation can be made on a single reference or a combination of several prior art references. An obviousness analysis involving two or more references generally requires a reason why a person of ordinary skill in the relevant field would have combined aspects of those references in the way the asserted patent claims do. I understand that the prior art references themselves may provide a suggestion, motivation, or reason to combine, but other times the link may be simple common sense. An obviousness analysis can recognize that market demand, rather than scientific literature, often drives innovation, and that is sufficient motivation to combine references.

38. A particular combination of prior art references may be made by merely showing that it was obvious to try the combination. For example, common sense is a good reason for a person of ordinary skill to pursue known options when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions.

39. A proper obviousness analysis focuses on what was known or obvious to a person of ordinary skill in the art, not just the patentee. For example, any need or known problem in the field at the time of invention that is supposedly addressed by the patent can provide a reason for combining the limitations in the manner claimed if the combination of prior art would address the same.

40. I understand that at least the following rationales may support a finding of obviousness: (1) combining prior art elements according to known methods to yield predictable results; (2) simple substitution of one known element for another to obtain predictable results; (3) use of a known technique to improve similar devices (methods or products) in the same way; (4) applying a known technique to a known device (method or product) ready for improvement to yield predictable results; (5) "obvious to try"—choosing from a finite number of identified,

predictable solutions, with a reasonable expectation of success; (6) a predictable variation of work in the same or a different field of endeavor if a person of ordinary skill would be able to implement the variation; (7) there existed a known problem for which there was an obvious solution encompassed by the patent's claims at the time of the claimed invention; (8) known work in one field may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to one of ordinary skill in the art; and (9) some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

41. I have been informed that one or more so-called "secondary considerations of non-obviousness" may impact the obviousness analysis if they are present. I have been informed that secondary considerations may include: (1) whether the invention proceeded in a direction contrary to accepted wisdom in the field; (2) whether there was a long felt but unresolved need in the art that was satisfied by the invention; (3) whether others had tried but failed to make the invention; (4) whether others copied the invention; (5) whether the invention achieved unexpected results; (6) whether the invention was praised by others; (7) whether others have taken licenses to use the invention; (8) whether experts or those skilled in the art at the making of the invention expressed surprise or disbelief regarding the invention; and (9) whether products incorporating the invention have achieved commercial success that is attributable to the invention.

42. I also understand that another indication of obviousness may be that others having ordinary skill in the field independently made the claimed invention at about the same time the inventor made the invention.

43. I also understand that for any such secondary consideration to be relevant, there must be a connection or "nexus" between the secondary consideration and the claimed invention. For example, commercial success of a product is relevant to obviousness only if the success of the product is attributable to the patented features of the claimed invention. If, on the other hand, commercial success is due to features of the product not claimed in the patent, due to claimed features that existed in the prior art, and/or due to advertising, promotion, salesmanship or the like, then any commercial success should not be considered an indication of non-obviousness.

C. Person of Ordinary Skill in the Art

44. I understand that claims are construed from the perspective of one of ordinary skill in the art to which the patented subject matter pertains at the time of the invention. Furthermore, I understand that a determination of the level of ordinary skill in the art includes as relevant factors (1) the educational level of the inventor; (2) the type of problems encountered in the art; (3) the prior solutions to those problems; (4) the rapidity with which innovations are made in the art; (5) the sophistication of the technology in the art; and (6) the educational level of active workers in the field.

D. Written Description and Enablement

45. I understand that 35 U.S.C. § 112, ¶ 1 imposes certain requirements on the form of a patent's disclosure: the specification must meet both the "written description" and "enablement" requirements. I understand that these requirements can be summarized as follows:

46. I understand that to have an adequate written description, the patent must convey with reasonable clarity to one skilled in the art that, as of the filing date sought, the patentee was in possession of the invention.

47. I understand that to demonstrate possession of the invention, the specification must permit a person with ordinary skill in the art to visualize or recognize the identity of the subject

matter purportedly described. Although the specification need not describe the claimed subject matter verbatim to demonstrate possession of the invention, generalized language will not suffice if it does not convey the detailed identity of an invention.

48. I understand that to have an adequate written description, each element of the claimed invention must be actually or inherently disclosed in the specification, and it is not sufficient that the missing claim element may be obvious from the specification. I understand that material added by amendment is not inherent to the original specification for the purposes of 35 U.S.C. § 112 if that amendment would broaden the scope of the invention beyond that which is supported in the initial disclosure.

49. I understand that to be an enabling disclosure, the specification must adequately disclose to one skilled in the art how to make or carry out the claimed invention without undue experimentation.

V. PERSON OF ORDINARY SKILL IN THE ART FOR THE ASSERTED PATENTS

50. In my opinion the person of ordinary skill in the art needed to have the capability of understanding the scientific and engineering principles applicable to the ’417 and ’330 Patents and would typically have a Master’s degree in electrical engineering or related field with emphasis in digital communications and at least one year of industry experience with wireless communication design, or a Bachelor’s degree in electrical engineering or related field with emphasis in digital communication and at least two years of industry experience with wireless communication design. As of the priority dates for the Asserted Patents, I would have qualified as a person of ordinary skill in the art.

VI. CLAIM CONSTRUCTION

51. I have reviewed the Court's Claim Construction Memorandum Opinion and Order dated March 15, 2019. In my analysis, I have applied the Court's constructions as well as the parties' agreed-upon constructions.

52. For the remaining claim terms, I have interpreted the terms as they would have been understood by a person of ordinary skill at the time of the invention considering the context of the claims themselves, the specifications, the figures, the prior art, and the prosecution histories. Consistent with these constructions and interpretations, I have considered the claims in light of the ordinary meaning of the claims based on the perspective of one of skill in the art and consistent with my experience in the field.

53. A summary of those terms of the '417 Patent for which a construction was agreed upon by the parties is provided below:

Term or Phrase	Court's Construction
"the ghost mobile node"	"a node, or a virtual node, that can operate on behalf of the mobile node and that is capable of registering with a foreign agent and allocating resources for the mobile node before the mobile node arrives in the physical area covered by the foreign agent."
"the ghost foreign agent"	"a virtual node corresponding to a foreign agent that can make a mobile node aware of the corresponding foreign agent's presence in a communication network proximate to the predicted future location of the mobile node."
"a ghost-mobile node that creates replica IP messages on behalf of a mobile node"	"a ghost-mobile node that copies IP messages on behalf of a mobile node"

54. A summary of those terms of the '330 Patent for which a construction was agreed upon by the parties is provided below:

Term or Phrase	Court's Construction
"wireless"	"without wires or cables, and only through air or vacuum"
"mobile node configured to wirelessly communicate"	"a device that sends and receives signals wirelessly"

Term or Phrase	Court's Construction
"wireless network nodes"	"an element of a network that sends and receives signals wirelessly"
"a packet-based wired communications network"	"a communications network in which packets of data are transmitted through wires or cables"
"fixedly-located"	"set at a particular location"

55. A summary of those terms of the '417 Patent for which a construction was provided by the Court is provided below:

Term or Phrase	Court's Construction
"foreign agent"	"a network node on a visited network that assists the mobile node in receiving communications"
"when the mobile node is located in a geographical area where the foreign agent is not physically present"	"when the mobile node is located outside of the region covered by the foreign agent"
"updating, in a mobile node, a location in a ghost mobile node"	"updating the ghost mobile node with a location of the mobile node"

56. A summary of those terms of the '330 Patent for which a construction was provided by the Court is provided below:

Term or Phrase	Court's Construction
"configured to variably adjust wireless communication characteristics"	"configured such that the controller can cause the wireless network nodes to adjust wireless communication characteristics of the wireless network nodes"
"communicatively linked"	"capable of transmitting and receiving signals via an interface"

VII. SUMMARY OF OPINIONS

57. My analysis below lists specific examples of where prior art references disclose, either expressly or inherently, each limitation of the Asserted Claims and/or examples of disclosures in view of which a person of ordinary skill in the art would have considered each limitation obvious. I have tried to identify the most relevant portions of the references. The references, however, may contain additional support for particular claim limitations. Other un-cited portions of the prior art references may provide context or aid in understanding the cited

portions of the references. Where I have cited to a particular figure in a reference, the citation should be understood to encompass the caption and description of the figure and any text relating to the figure. Conversely, where I have cited to particular text referring to a figure, the citation should be understood to include the figure as well.

58. I have primarily focused my analysis and discussion on the following prior art. Based upon my review and analysis, as discussed below, it is my opinion that the Asserted Claims of the ’417 Patent are anticipated and/or rendered obvious by the following prior art references, alone or in combination:

- Liu et al., “A Virtual Distributed System Architecture for Supporting Global-distributed Mobile Computing” (“Liu paper”)
- U.S. Patent No. 5,825,759 (“Liu patent”)
- U.S. Patent No. 6,385,454 (“Bahl”)
- US Patent Publication No. 2002/0131386 (“Gwon I”)
- U.S. Patent Publication No. 2003/0016655 (“Gwon II”)
- U.S. Patent Publication No. 2002/0045450 (“Shimizu”)
- 3GPP UMTS Standard (Releases 99 to Release 5)

59. Based upon my review and analysis, as discussed below, it is my opinion that the Asserted Claims of the ’330 Patent are anticipated and/or rendered obvious by the following prior art references, alone or in combination:

- U.S. Patent No. 6,272,337 (“Mount”)
- AirAccess C2K CDMA Network Emulator Operations Manual (“AirAccess”)
- U.S. Patent Publication No. 2002/0183054 (“Rimoni”)
- Korean Patent Application Publication No. KR2001-0048715 (“Cho”)
- NIST Net – A Linux-based Network Emulation Tool (“NIST”)

- ONE: The Ohio Network Emulator ("ONE")

VIII. BACKGROUND OF THE TECHNOLOGY AND STATE OF THE ART

A. The '417 Patent

1. General Architecture of Communications Networks

60. Engineers, including those skilled in both wired and cellular systems, commonly describe communications between communications networking entities by the Open Systems Interconnection (OSI) 7-layer model. The top-most layer is called the "Application Layer" (layer 7), which is the point at which the communicating entity (such as a person) interfaces with the communications channel in a manner specific to a given application. An example protocol at the Application Layer is the "HyperText Transfer Protocol" (or "HTTP" or "http"), which is used to access websites over the Internet. Applications are intended to be independent of the details of the actual communications channel involved. In contrast, the two lowest layers of the OSI model are the "Physical Layer" (or "PHY," layer 1) and the "Data Link Control Layer" (or "DLC," layer 2), which are very specific to the physical media over which communications occurs.

	Layer	Title
Higher Layers	7	Application
	6	Presentation
	5	Session
Lower Layers	4	Transport
	3	Network
	2	Data Link
	1	Physical

Table 0.1: OSI Reference Model

Taylor et al., "Internetworking Mobility: The CDPD Approach" (1996) ("Taylor") at 10.

61. In all communications networks, the PHY layer defines many critical attributes of the media transfer path including at least the channel encoding, modulation format, channel access multiplexing, carrier frequency, and transmitted signal level, as well as explicitly or implicitly

defining the reverse procedures necessary for the receive path. The PHY layer transmits and receives “bits” converted into “signals.” Examples of different physical media include acoustic vibrations, electric fields, magnetic fields, radio transmissions, infrared emissions, electrical conductions, and optical fiber propagations.

62. The “middle” layers of the communications stack are, in theory, both application and media independent and include layer 3 (the “network layer”), layer 4 (the “transport layer”), layer 5 (the “session layer”), and layer 6 (the “presentation layer”). The term “network” is understandable to a layperson and is often used even by engineers in the context of “a series of points interconnected by communications channels.” However, for purposes of analyzing the details of communications systems involving a “network layer,” it is important to understand that the purpose of the “network layer,” which is a defining characteristic of any communications “network,” is to perform routing and relaying services necessary to support data transmission over interconnected networks. Examples of the network layer 3 include the Internet Protocol (or “IP”), which is used to exchange data within the Internet and many private packet data networks (or “PDNs”). Notably, the network layer is the only layer in which it is technically correct to describe discrete groups of data bits being exchanged as “packets” (or “datagrams”), as opposed to “frames” at the DLC layer, “segments” at the transport layer, or “messages” at the session layer and above.

(a) The Internet and the Internet Protocol (IP)

63. The Internet is a global “network of networks” that interconnects “hosts” across all such networks. The Internet is effectively defined by a collection of protocols known as the “Internet Protocol Suite” that operate across multiple layers of the OSI model but the core protocols of most general interest to all Internet-based applications are expressed in terms of a “Transport Layer,” an “Internet Layer,” and a “Link Layer.” The Internet is a transport mechanism for messages that are exchanged between peer entities that operate at layer 5 and above.

64. The Internet Layer (which corresponds to layer 3, the network layer, of the OSI model) uses IP packets of data wherein each packet carries a "source IP address" and a "destination IP address." Each IP address (based on IPv4, which was prevalent at the time of filing of the '417 Patent) is 32 bits long and comprises a network address portion and host address portion as defined by the address "class" and determined by a "subnet mask." Sending and receiving packets amongst a set of hosts within a given network address is accomplished via a "router" which stores IP packets received at one physical "port" or interface and then based on the addresses and certain local rules forwards (or "routes") these IP packets to an appropriate one of its available ports or interfaces. This process is also sometimes referred to as "packet switching," and thus routers are sometimes referred to as "packet switches" (or occasionally "IP switches").

65. The Transport Layer of the Internet Protocol Suite (which corresponds to layer 4, the transport layer, of the OSI model) sends and receives "messages" from higher layers from one to another via logical "source" and "destination" "ports" (these are not physical ports on a network equipment device). A 16 bit "port number" wherein some port numbers correspond to specific message types and others are dynamically assignable identifies each port at each host. The best known Transport Layer protocol (and the original one in the Internet Protocol Suite) is the Transmission Control Protocol ("TCP"). At the source host, TCP divides messages into appropriate lengths and appends a TCP header with the source and destination port numbers, a sequence number, and an acknowledgement (and optionally a timestamp), and then passes the "segment" to the Internet Layer for delivery to the destination host. Applications communicating by TCP/IP can uniquely identify segment delivery by the combination of port numbers, sequence number, host addresses, and network addresses. Failure to receive a TCP acknowledgement leads to repeated transmission of any given TCP segment. Thus, TCP is intended for relatively reliable

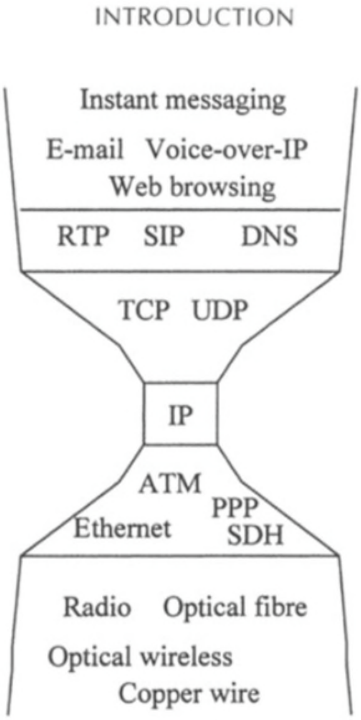
delivery, not low latency. Another well-known transport layer protocol is the "User Datagram Protocol" (or "UDP"). With UDP, segments are still directed to specific source and destination port numbers but without any sequence information or repeated attempts at delivery.

66. The Link Layer of the Internet Protocol Suite (which effectively corresponds to the combination of layer 2, the data link layer; and layer 1, the physical layer, of the OSI model) is a logical construct that in practice depends on the physical media in which the frames of data are being transported. For example, one common Link Layer protocol used with IP networking in conjunction with many layer 2 protocols is the "Address Resolution Protocol" (or "ARP"). ARP resolves ambiguities between IP network addresses at the Internet Layer and "physical" addresses (most commonly "MAC" addresses) at the Link Layer by broadcasting ARP probes within the Link Layer.

67. Notably, ARP itself is not part of the IP protocols (as defined by the IETF as RFC 791), but is used by communications nodes to communicate with other nodes to convert known layer 3 protocol addresses (IP addresses for example) to layer 2 addresses (Ethernet MAC addresses for example). *See, e.g.*, IETF RFC 791, "Internet Protocol, DARPA Internet Program Protocol Specification" (1981), https://tools.ietf.org/pdf/rfc791.pdf. ARP was defined by IETF RFC 826 in 1982. IETF RFC 826, "An Ethernet Address Resolution Protocol" (1982), https://tools.ietf.org/pdf/rfc826.pdf.

68. IP communications between nodes at the network layer are carried by the lower layers, including link layer networks such as Ethernet or cellular packet data radio access networks. Whereas IP communications require IP addresses to route data properly from source to destination, the link and physical layer protocols of the OSI reference model do not. Additional examples of

protocols which may be used to carry IP packets, or be carried within IP packets as payload, are provided in the following figure.



Wisely, "IP for 3G – Networking Technologies for Mobile Communications" (2002) ("IP for 3G"), at 7.

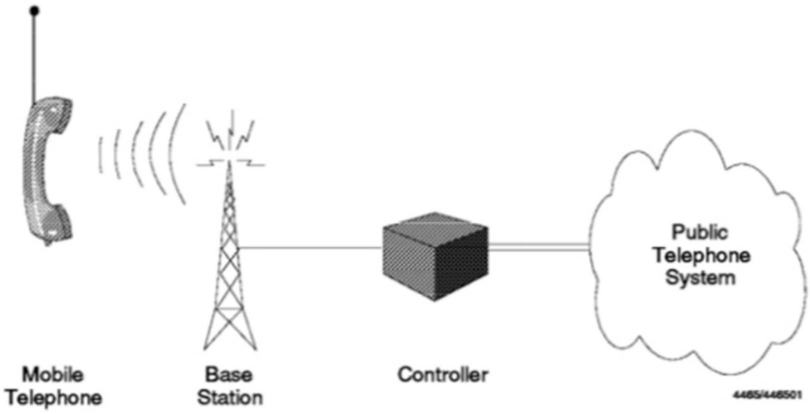
2. A Brief History of Cellular Mobile Communications

(a) Early Cellular Development

69. I understand that Mobility Workx contends that the '417 Patent applies to wireless cellular communications, particularly Long Term Evolution (LTE). Therefore, it is useful to provide a background of the state of the art in wireless communications and cellular mobile technologies at the time of the filing, and before the alleged inventions claimed by the '417 Patent.

70. The first mobile telephone system was deployed in St. Louis in 1946, having a 50 mile coverage range. This service was deployed in 25 states within the following year. *See* IBM, "An Introduction to Wireless Communications (1995) ("IBM 1995"), at 6. This system used a

number of base stations, each having a frequency modulated transmitter, and was connected to the wired telephone network using a controller.



IBM 1995 at Fig. 1.

71. This system was replaced in the 1960s with a system called the “Improved Mobile Telephone Systems” (IMTS), and was a precursor to the so-called cellular service. It used a larger number of smaller cells operating at lower power to increase the capacity of the system. Additionally, the system provided for a number of channels per base station.

72. Every cellular system must apportion some amount of over-the-air resources for user terminals, like cell phones, for some period of time to transmit communications to a base station. This communications link from user terminal to base station is referred to as the “uplink,” or “reverse link” (while the communications link from base station to user terminal is referred to as the “downlink,” or “Forward link”):

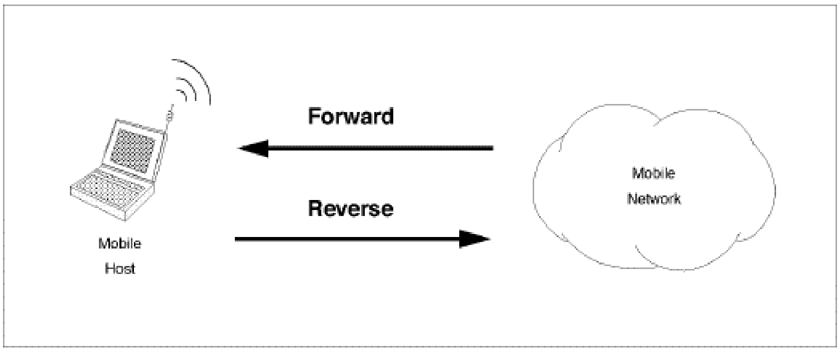


Figure 0.11: Directions of Mobile Transmission

Taylor at 20.

73. Cellular mobile voice and/or data devices additionally must perform control operations with the cellular networks. These control operation may be grouped into some general categories: Radio Resource Management, Mobility Management, and Service (or Session) Management.

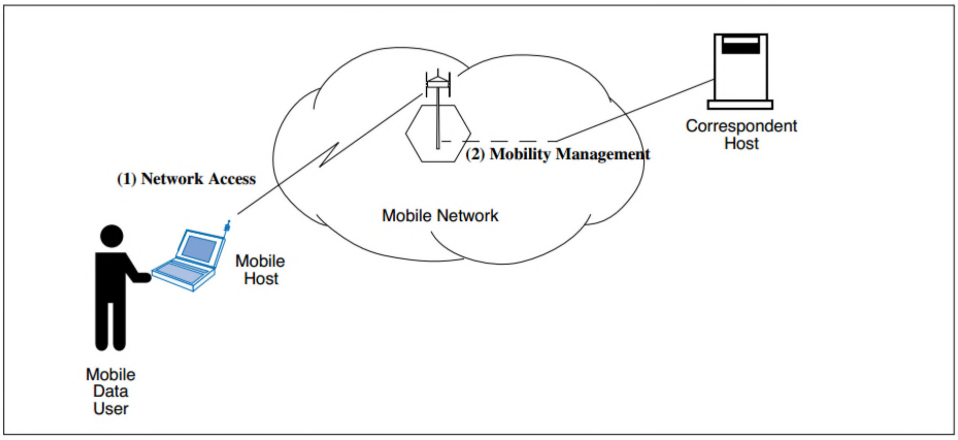


Figure 1.5: Two Basic Aspects of Mobile Communications

Id. at 28.

74. Radio Resource Management is typically concerned with assuring proper (effective and efficient) use of the RF medium and is part of accessing the mobile network. *Id.* at 43. In many standards Radio Resource Management involves the mobile device exchanging messages and

transmissions directly with the base station, or the controller of the base station. The radio resource control functions may include aspects of handover.

> **Radio resource management functions** Allocation and maintenance of radio communication channels are provided by these functions. The GSM radio resources are dynamically shared between the circuit mode and GPRS. The GPRS radio resource management is concerned with the allocation and release of timeslots for a GPRS channel; monitoring GPRS channel utilization; congestion control; and the distribution of GPRS channel configuration information that is broadcast on the common control channels.

Steele, “GSM, cdmaOne and 3G Systems” (2001) (“Steele”), at 418.

75. Mobility Management provides for the ability to send and receive communication wherever a mobile device is located. This category sometimes is referred to as, or otherwise includes, location management. Furthermore, Mobility Management involves the handover of a mobile device between cells (to be discuss in more detail below), depending upon the system. At the least, it includes the location management aspects related to changing the point of attachment within one or more radio access networks.

76. Service or Session Management provides for access to services within the radio access network. For example, in prior art cellular systems such as GSM (Global System for Mobile communications), GPRS (General Packet Radio Services), and UMTS (Universal Mobile Telecommunications System), services or sessions are invoked that are distinct from Mobility Management registration and authentication, and are related to a user device connecting and disconnecting from services within the network. For example, in GSM, connection management involves circuit-switched call control, so-called supplemental services, and SMS (short messaging services). The services connection management functions generally must determine which services the user (*e.g.*, based on the user’s subscriber identification module (SIM)) is authorized to receive, and perform accounting and charging of the user related to use of those services. In GPRS and

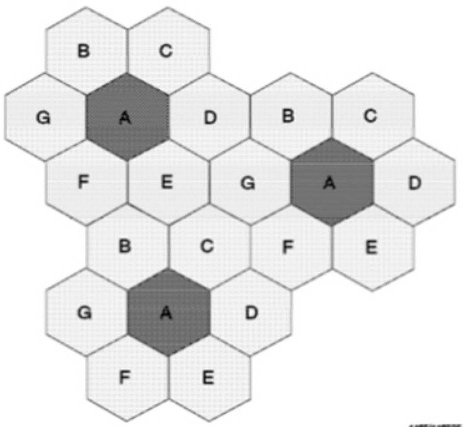
UMTS, access to circuit-switched voice connections and access to packet data services are invoked separately.

(b) Cellular Network Planning

77. To avoid interference between the signals of adjacent base stations and wireless phones within the coverage areas of those base stations, the reuse of the same channels within the adjacent coverage areas was not allowed. Rather, the system required skipping at least one base station's use of a given channel, prior to the reuse of that same channel. (IBM 1995 at 6.) This approach become known as a "frequency reuse pattern" and will be discussed in more detail below.

78. The first cellular systems were developed by Bell Laboratories in the 1970s and deployed in Chicago, beginning in 1979. This system was referred to as the "Advance Mobile Telephone System" (AMPS). There were similar variants deployed in other countries shortly following the development of AMPS.

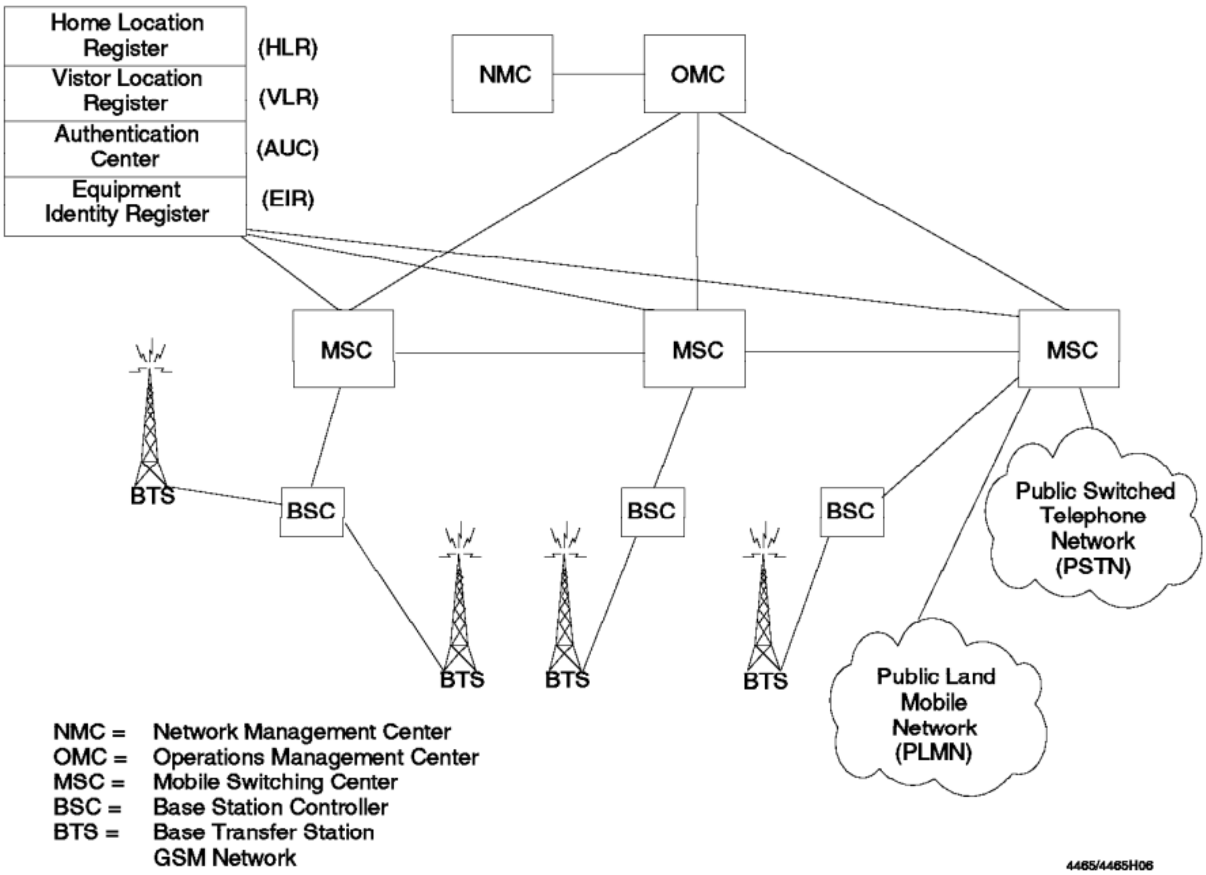
79. An example of an early frequency reuse pattern is depicted in the following figure.



IBM 1995 at 7 (Fig. 2).

80. Referring to the above figure, the letters in each "cell" represent a different subset of the available channels of operation of a cellular system. One can readily see that no two adjacent

cells have the same sets of assigned operating frequency channels, thus reducing the interference between the cells. The AMPs system included a "mobile switching center" or MSC to allow for the transfer of a call form one cell to the next as a mobile phone traverses the cells. This is referred to as a handoff or handover. AMPS was referred to as a first generation system (1G).



IBM 1995 at 42 (Fig. 14).

81. The borders of coverage depend upon the wireless propagation characteristics of the signals between the mobile devices and the respective base stations, and can vary based upon a number of factors including changes in physical obstructions (called shadow fading or blocking), changes in reflections of the signals themselves (called flat fading and frequency selective fading), the number of other devices operating in the same cell (cell loading and same cell interference), and the number of other cells operating in the same area at the same frequencies (other cell

interference) as several examples. At some frequencies of operation, even environmental factors such as rain may reduce the range a cell may cover. As a result, borders of cells are not regular as many diagrams depict for simplicity sake (such as the one referred to above), but are variable and irregular (see figure below); often including "islands" of coverage by other cells within a physically closer cell. As a result, physical location was (and is not) generally used to determine coverage regions of cells in real systems. *See* Rappaport, Wireless Communications: Principles and Practice (1996) ("Rappaport") at § 3 (including Table 3.2, and § 3.10), Table 3.3 and § 4; *see also* Fujimoto, Network Simulation (2007) ("Fujimoto") at § 4.2 ("This signal strength is a function of many variables, including the transmitter power, transmitter antenna gain factor, receiver antenna gain factor, antenna orientations, terrain obstructions, weather, and ambient electromagnetic interference, just to name a few.").

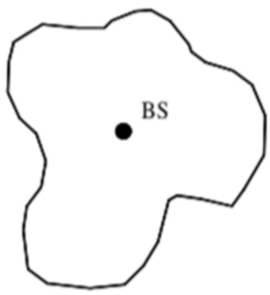


Figure 1.3: A single cell.

Steele at 7 (Fig. 1.3).

> The dimensions of a cell are limited by the transmitter and receiver performances, the path loss, shadow fading and other factors described in the previous section. If we are going to cover wide areas we will need to tessellate cells, and switch a MS between BSs as it roams throughout the network. If hundreds or thousands of cells are required, then some cells must operate with the same carrier frequencies. This phenomenon is called frequency reuse.

Id. at 7.

82. Furthermore, the coverage areas of cells are not bounded by the depicted lines in the forgoing figures, but rather cells overlap on their coverage areas to provide for the continuity of service.

> The SIR can be increased by replacing the omnidirectional BS antennas with directional ones. Typically, directional antenna radiation patterns span 120 in the horizontal plane with the direction of the maximum radiation of each antenna spaced by 120 as shown in Figure 1.10. Each antenna radiation pattern is slightly in excess of 120, creating overlap- ping regions where each antenna is able to communicate with an MS. These regions are important as they facilitate an MS travelling between sectors to be switched from one cell site sectorised antenna to another, a process called intrasector handover or hand off. In Figure 1.10 we also show small back lobes in the antenna pattern. These cannot be avoided with practical antennas, and in general they do not create significant interference between sectors.

Steele at 13.

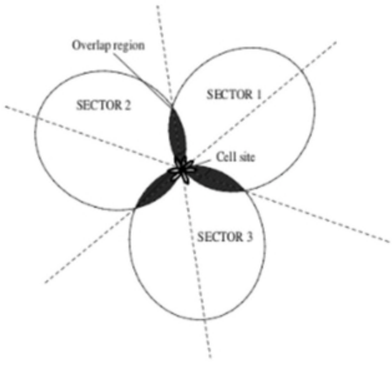
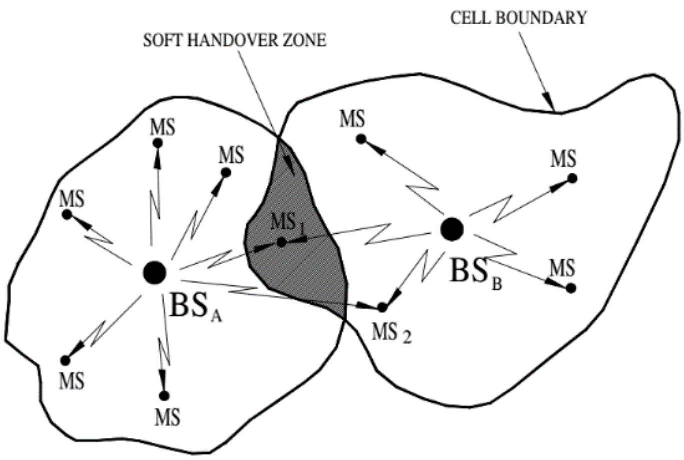


Figure 1.10: Antenna patterns for a cell site having three 120° sectors.

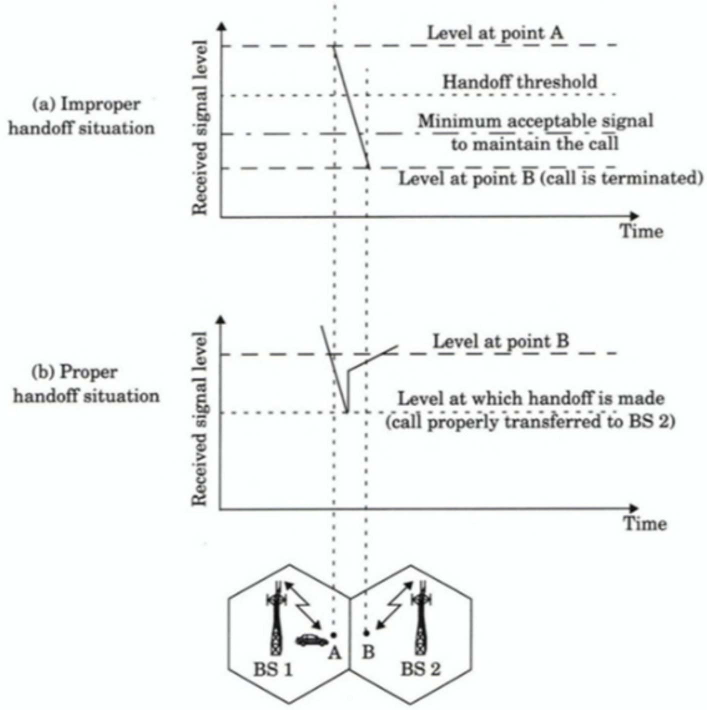


Id. at 14 (Fig. 1.10), 42 (Fig. 1.28).

83. In the following, an example of overlapping coverage area is provided. While a "soft" handover zone is depicted, a similar or even larger overlap would be present in relation to "hard" handovers (such as depicted below), particularly when an inter-frequency handover is performed. A soft handover is one in which connections with both cells at the same frequency are maintained simultaneously, generally combining these signals for performance benefits

(sometimes called “make before break”). A hard handover is one in which the connection to one base station is terminated prior to the connection to another is made (sometimes called “break before make”). This will be discussed in more detail below.

84. Referring to the figure below, as a mobile station moves from the coverage area of base station 1 (BS1) to that of base station 2 (BS2), the signal level from base station 1 drops below the “handoff threshold.” If additionally, the signal level received from BS2 is above the “minimum acceptable level,” handoff is performed. It should be noted that the actual coverage area of BS1 can extend beyond even this level to “point B” where the minimum level to communicate with BS1 ends. Such an arrangement is typical in that the coverage areas of adjacent cells overlap. Further, the points where the signal power thresholds are reached while a mobile is moving from BS1 to BS2, in contrast to moving from BS2 to BS1, will typically be different. It should be noted that in any event, the handoff only occurs after the mobile is receiving signals from the next base station above a minimum acceptable level. Said differently, the mobile is already within the coverage area of the base station to which it will hand over when the decision to handover is made, resulting in a reactive process based upon having measured the signal rather than predicting it. Such a reactive process was known to those of skill in the art starting at least in the early 1990s.



Rappaport at 31.

85. In the above cells, an idealized path loss was used, similar to the following figure including significant cell coverage areas between the cells. As discussed above there is not an "ideal cell boundary" in practice, as hysteresis and offsets are used in the cells handover algorithms to reduce the handover occurrences and to minimize "ping-pong" effects where a mobile switches back and forth between cells repeatedly, particularly in light of real cell coverage patterns.

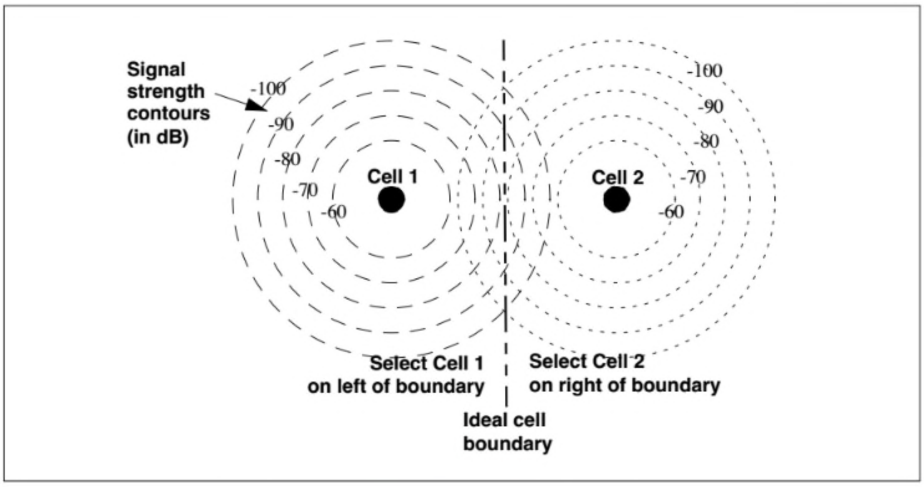


Figure 5.20: Theoritical Cell Selection

Taylor at 162 (Fig. 5.20).

86. However, the ideal propagation model cannot be assumed as this is not the case in the real world, each base station will have different path loss rate versus distance. For example, the following figure shows the overlap region of Cell 2 covering all the way to Cell 1, but the coverage of cell 1 ending prior to the distance of cell 2 (for a -100 dB signal strength level). Further the constant signal strength rings are irregular and not reliable for distance estimation.

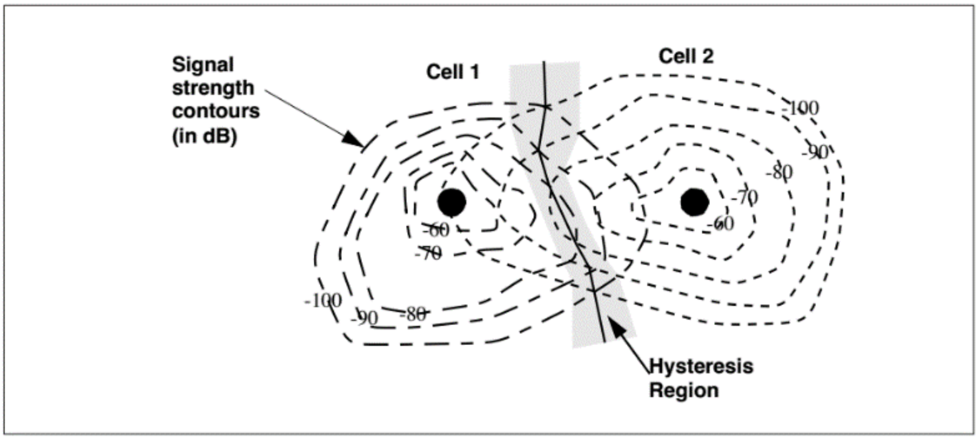


Figure 5.23: Example of Hysteresis Region of 10 dB

Id. at 164 (Fig. 5.23).

87. Furthermore, the following illustrates a hysteresis approach being used in the cellular handover process:

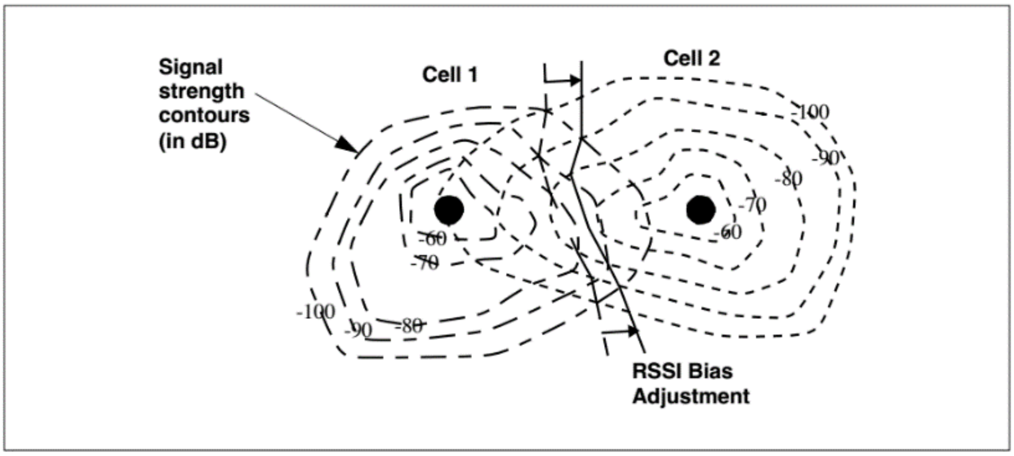


Figure 5.24: Example of Received Signal Strength Parameter of -10 dB

Id. at 165 (Fig. 5.24).

88. In the above, the point of handover will differ depending upon various factors that affect signal strength, as well as the RSSI (received signal strength indication) bias the operator configures for their network-initiated handover decisions. Such a bias would result in a process such as that in the handover diagram above providing for "proper" and "improper" handover examples.

89. As mentioned above, wireless fading and blockage based upon the environment will affect the coverage area of a cell and the signal level received at a particular location, as illustrated in the figure below.

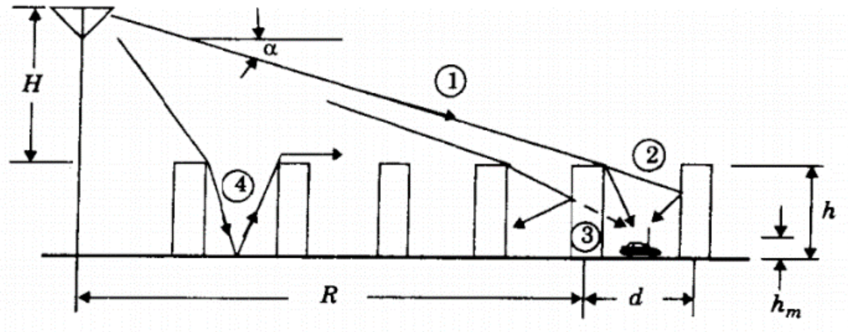


Figure 3.25

Rappaport at 121 (Fig. 3.25).

90. For example, the following figure depicts the effect multipath signals can have when combining at different frequencies, at the same location. The result being that in a narrow frequency band, the signal level may be measured at significantly different values. In my experience this can vary as much as 25 or 30 Decibels (dB) in received signal strength (or more), at the same location.

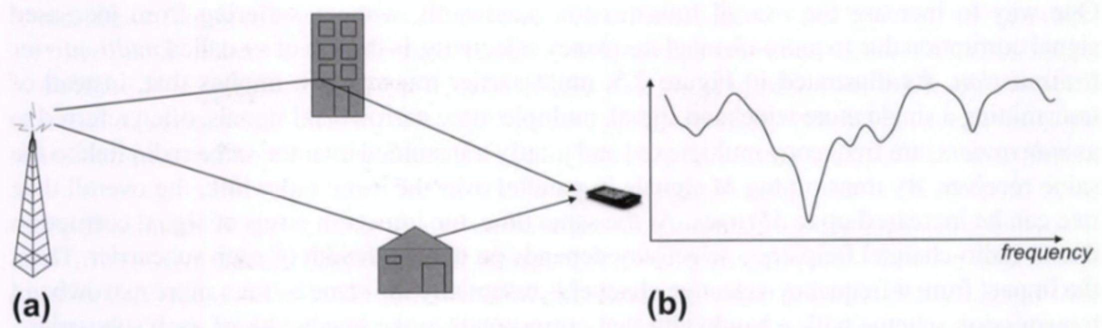


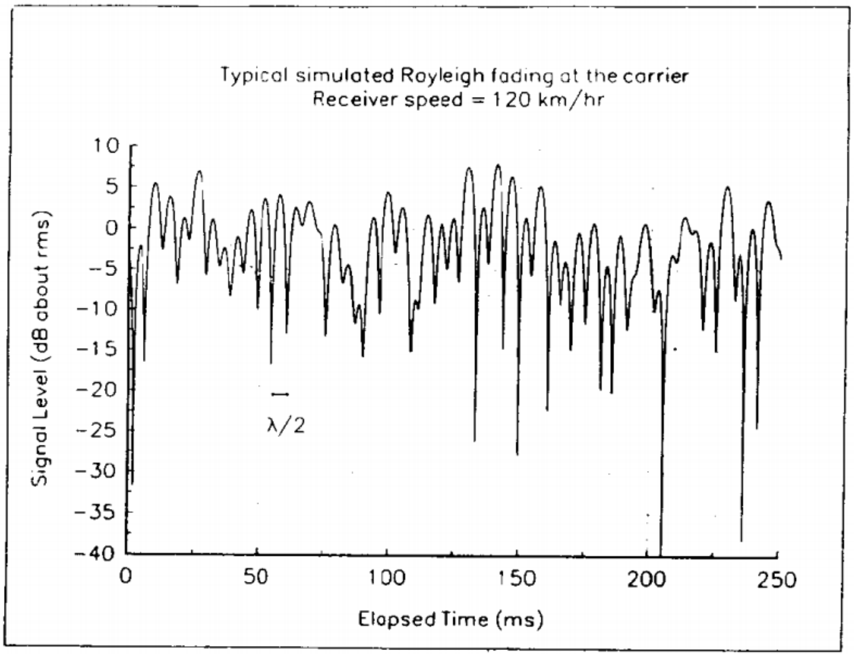
FIGURE 2.4

Multi-path propagation causing time dispersion and radio-channel frequency selectivity

Dahlman, "4G: LTE/LTE-Advanced for Mobile Broadband" (2014) ("Dahlman"), at 25 (Fig. 2.4).

91. The combination of the multipath signals at one location is frequency dependent, based upon the relative phases of those signals. Therefore, movement of a mobile can have a similar effect to that of frequency. The following figure depicts the received signal level over time, as a mobile receiver moves at 120 km/hr. It can be seen that the signal fades over short periods of

time (analogous to over ranges in frequency while stationary), which is consistent with my experience stated above. In some instances the signal fades in excess of 45 dB of signal unrelated to appreciable signal loss dues to being further from the transmitter).



Rappaport at 173 (Fig. 4.15).

(c) Early Cellular Systems

92. Some examples of early (prior art) cellular system are provided in the following table.

Table 1.1 Major Mobile Radio Standards in North America

Standard	Type	Year of Introduction	Multiple Access	Frequency Band	Modulation	Channel Bandwidth
AMPS	Cellular	1983	FDMA	824-894 MHz	FM	30 kHz
NAMPS	Cellular	1992	FDMA	824-894 MHz	FM	10 kHz
USDC	Cellular	1991	TDMA	824-894 MHz	$\pi/4$-DQPSK	30 kHz
CDPD	Cellular	1993	FH/ Packet	824-894 MHz	GMSK	30 kHz
IS-95	Cellular/ PCS	1993	CDMA	824-894 MHz 1.8-2.0 GHz	QPSK/ BPSK	1.25 MHz
GSC	Paging	1970's	Simplex	Several	FSK	12.5 kHz
POCSAG	Paging	1970's	Simplex	Several	FSK	12.5 kHz
FLEX	Paging	1993	Simplex	Several	4-FSK	15 kHz
DCS-1900 (GSM)	PCS	1994	TDMA	1.85-1.99 GHz	GMSK	200 kHz
PACS	Cordless/ PCS	1994	TDMA/ FDMA	1.85-1.99 GHz	$\pi/4$-DQPSK	300 kHz
MIRS	SMR/PCS	1994	TDMA	Several	16-QAM	25 kHz

Rappaport at 7 (Table 1.1).

93. Similarly, the following wireless standards were developed for deployment in Europe:

Table 1.2 Major Mobile Radio Standards in Europe

Standard	Type	Year of Introduction	Multiple Access	Frequency Band	Modulation	Channel Bandwidth
E-TACS	Cellular	1985	FDMA	900 MHz	FM	25 kHz
NMT-450	Cellular	1981	FDMA	450-470 MHz	FM	25 kHz
NMT-900	Cellular	1986	FDMA	890-960 MHz	FM	12.5 kHz
GSM	Cellular /PCS	1990	TDMA	890-960 MHz	GMSK	200 kHz
C-450	Cellular	1985	FDMA	450-465 MHz	FM	20 kHz/ 10 kHz
ERMES	Paging	1993	FDMA	Several	4-FSK	25 kHz
CT2	Cordless	1989	FDMA	864-868 MHz	GFSK	100 kHz
DECT	Cordless	1993	TDMA	1880-1900 MHz	GFSK	1.728 MHz
DCS-1800	Cordless /PCS	1993	TDMA	1710-1880 MHz	GMSK	200 kHz

Id. at 8 (Table 1.2).

94. The above systems are all early first generation (1G) or second generation (2G) networks standards. A discussion of cellular network standards follows, including subsequent generations of standards.

(d) Cellular Standards and Standards Development Organizations

95. A standards setting organization (or standards development organization ("SDO")) is any organization whose primary activity is producing technical standards to address the needs of companies that want to implement that technology. In particular, telecommunication SDOs promote cooperative standards for telecommunications equipment and systems through standards development, which provide manufacturers and vendors with a universal approach to develop products and compete in the marketplace. The existence of standards enhances the business environment by lowering development costs and by allowing diverse networks to communicate.

96. As discussed above, various voice and data standards were developed, standardized and deployed at the time of the alleged invention of the patent-in-suit. The prior art voice and data

standards included AMPS (IS-41), TDMA (IS-54 and IS-136), CDPD, Mobitex, ARDIS, CDMA (IS-95), UMTS Release 99, UMTS Release 4, and UMTS Release 5 and others.

97. I understand that Mobility Workx is accusing Verizon's LTE network based on the LTE standard, which was developed by, or are currently controlled by, an organization called the 3rd Generation Partnership Project ("3GPP"). The prior art cellular standards GSM, GSM/GPRS, EDGE, and UMTS up to at least Release 5 (published in mid-2002), were prior art to the Asserted Patent, and were developed by, or are currently controlled by the 3GPP. Each predecessor standard provided the foundation from which each subsequent standard evolved, ultimately resulting in the Long Term Evolution (LTE) standard.

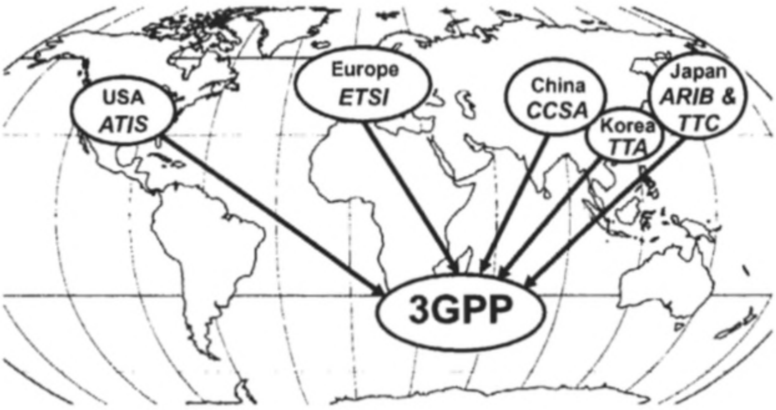


Figure 1.2: 3GPP is a global partnership of six regional SDOs.

Sesia et al., "LTE: The UMTS Long Term Evolution, From Theory to Practice" (2011) ("Sesia") at 5 (Fig. 1.2).

98. The 3rd Generation Partnership Project ("3GPP") is a widespread SDO that is responsible for creating specifications that define 3GPP technologies that span from the first generation (1G) to the fourth generation (4G) as shown in the figure below:

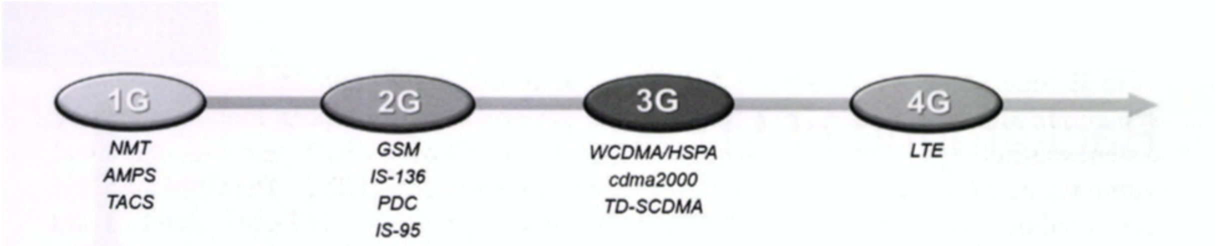
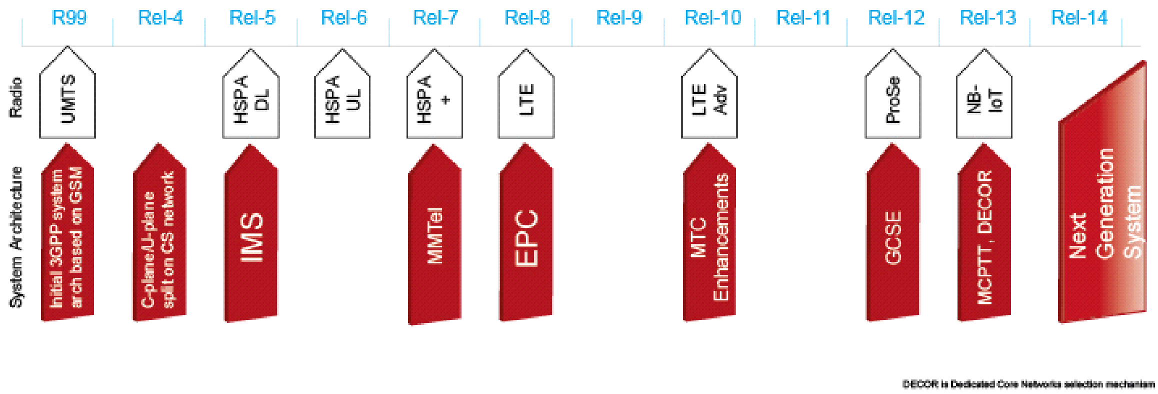


FIGURE 1.1

Generations of mobile communication systems

Dahlman at 2 (Fig. 1.1).

99. Over the years, the 3GPP organization has gained widespread confidence among GSM and UMTS (WCDMA) users, vendors, and service providers. The figure below shows how one family of cellular standards has evolved, beginning with the GSM standard that was initially introduced in the early 1990s. The right-hand side of the arrow in the figure below represents that the 3GPP is now working on the creation of specifications for future releases of LTE-Advanced network standards, as well as 5G standards. In general, 3GPP is responsible for coordinating the creation and publication of the specifications for each new release and preserving the specifications associated with the previous releases for each type of network. The 3GPP Family Technology Evolution is depicted below:



3GPP, About 3GPP, http://www.3gpp.org/About-3GPP (last visited Oct. 3, 2018).

100. Below is a summary of relevant new features and release dates. *See* 3GPP, Releases, http://www.3gpp.org/specifications/releases (last visited Oct. 3, 2018). I provide a more detailed explanation of these releases below.

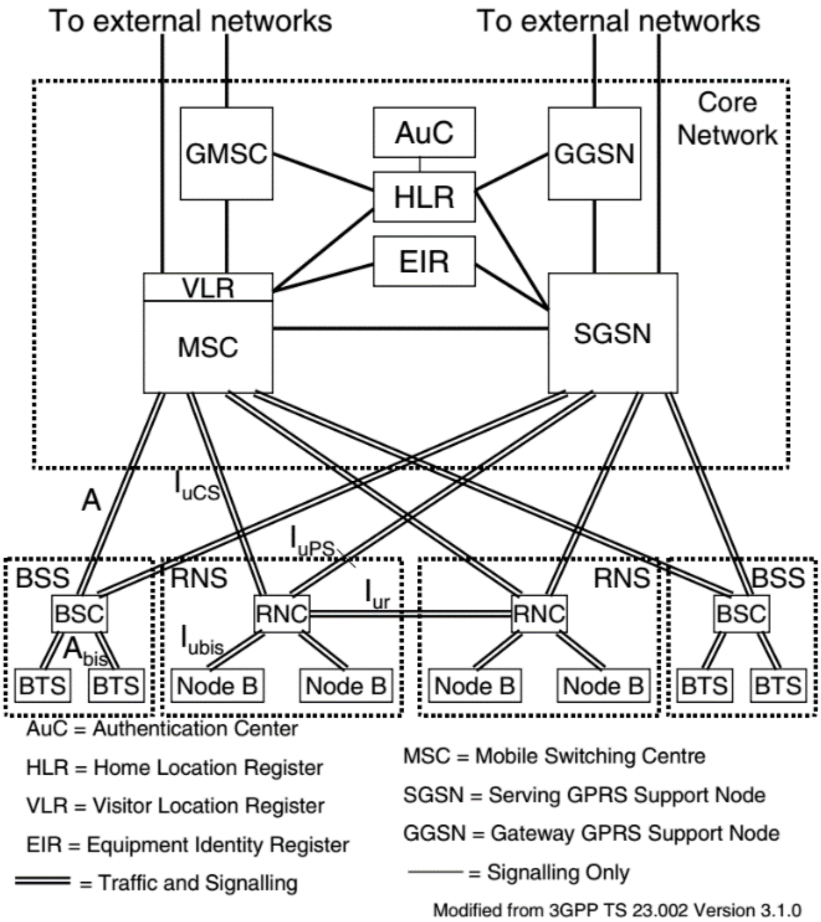
Release	**Publication (Stable) Date**	**Highlighted Features**
Release 97	4/15/1996	GSM/GPRS (IP packet data network)
Release 99	12/17/1999	UMTS including GPRS
Release 4	6/21/2001	IP interface for Iu-CS (Voice calls over IP interface from RNC to MSC Server (control) and to Media Gateway (MGW) for call media
Release 5	9/12/2002 (versions available earlier)	IP transport network from NodeBs to RNC (Iub) and between RNCs (Iur) interfaces. High Speed Downlink packet Access (HSDPA) Addition of the IP Multimedia Subsystem (IMS) for VoIP services (See 23.228v5.1 6/2002 "IP Multimedia Subsystem (IMS), stage 2".)

101. All the above releases up to and including release 5 were prior art the ’417 Patent. Each release performed “reactive” handovers based upon the mobile device performing the measurements of its current cell and neighboring cells—where the mobile must be within the coverage area of those particular cells to perform such measurements—and reporting these measurements to the network. Handovers in cellular systems in which the network determines if and when a handover is required are called “Network-Initiated” handovers, and require measurements from the mobile device (and the base stations in some cases) to assist in the mobility management decisions. Such networks are also referred to as utilizing “mobile-assisted” handoffs or handovers.

3. Overview of the 3G UMTS Cellular Network Architecture

102. The Universal Mobile Telecommunications System (UMTS) is a 3G cellular communications system for networks evolved from the 2G Global System for Mobile

Communications (GSM) standard. The following citations provide a general overview of the UMTS network architecture, including the various network nodes and the interfaces by which they are interconnected.



Steele at 425 (Fig. 6.5).

> The RNCs and base stations are collectively known as the UTRAN (UMTS Terrestrial Radio Access Network). From the UTRAN to the Core, the network is divided into packet and circuit-switched parts, the Interface between the radio access and core network (Iu) being really two interfaces: Iu (PS - Packet switched) and Iu (CS - circuit-switched). Packet traffic is concentrated in a new switching element - the SGSN (Serving GPRS Support Node). The boundary of the UMTS core network for packets is the GGSN (Gateway GPRS Support Node), which is very much like a normal IP gateway and connects to corporate Intranets or the Internet.

Below is a quick guide to some of the functionality of each of these elements and interfaces:

3G Base Station (Node B) - The base station is mainly responsible for the conversion and transmission/reception of data on the air interface (U_u) (Figure 2.5) to the mobile. It performs error correction, rate adaptation, modulation, and spreading on the air interface. Each Node B may have a number of radio transmitters and cover a number of cells. (The Node B can achieve soft handover between its own transmitters (this is called softer handover), the Node B also sends measurement reports to the RNC.

RNC - The RNC is an ATM switch that can multiplex/demultiplex user packet and circuit data together. Unlike in GSM, RNCs are connected together (through the I_{ur} interface) and so can handle all radio resourcing issues autonomously. Each RNC controls a number of Node Bs - the whole lot being known as an RNS - Radio Network System. The RNC controls congestion and soft handover (involving different Node Bs) as well as being responsible for operation and maintenance (monitoring, performance data, alarms, and so forth) within the RNS.

SGSN - The SGSN is responsible for session management, producing charging information, and lawful interception. It also routes packets to the correct RNC. Functions such as attach/detach, setting up of sessions and establishing QoS paths for them are handled by the SGSN.

GGSN - A GGSN is rather like an IP gateway and border router - it contains a firewall, has methods of allocating IP addresses, and can forward requests for service to corporate Intranets (as in dial-up Internet/Intranet connections today). GGSNs also produce charging records.

MSC - The Mobile Switching Centre/Visitor Location Register handles connection- orientated circuit switching responsibilities including connection management (setting up the circuits) and mobility management tasks (e.g. location registration and paging). It is also responsible for some security functions and Call Detail Record (CDR) generation for billing purposes.

GMSC - The Gateway MSC deals with incoming and outgoing connections to external networks (such as the public fixed telephony network) for circuit-switched traffic. For incoming calls, it looks up the serving MSC by querying the HLR and sets up the connection the MSC.

> **HLR** - The home location register, familiar from GSM, is just a large database with information about users, their services (e.g. whether they are pre- or post-pay, whether they have roaming activated, and the QoS classes to which they have subscribed). Clearly, new fields have been added for UMTS - especially relating to data services.

Wisely at 33-34.

103. Similar network elements in GSM were renamed in UMTS. The network elements of GSM related to those of UMTS as follows:

Table 6.4: GSM and UMTS terminologies of some key entities.

GSM	UMTS
Mobile station (MS)	User equipment (UE)
Base station transceiver (BTS)	Node B
Base station controller (BSC)	Radio network controller (RNC)
Base station subsystem (BSS)	Radio network subsystem (RNS)
Subscriber identity module (SINM)	Universal subscriber identity module (USIM)

Steele at 424 (Table 6.4).

(a) The Packet Data Architecture of Release 5 GPRS UMTS

104. The following citations provide a description of the packet data architecture of Release 5 GPRS and UMTS.

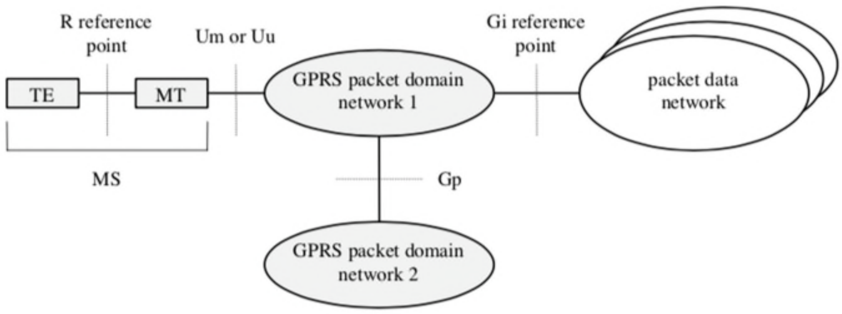


Figure 1: GPRS Access Interfaces and Reference Points

3GPP TS 23.060 v5.1.0 at § 5.1 (Fig. 1).

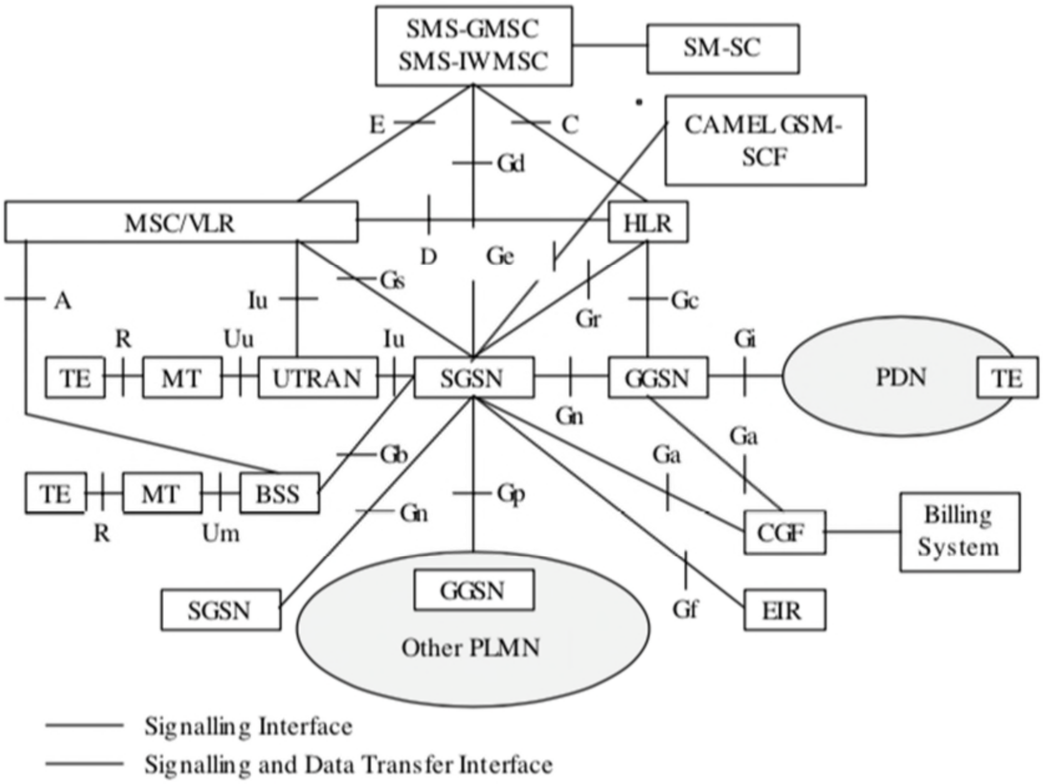


Figure 2: Overview of the GPRS Logical Architecture

3GPP TS 23.060 v5.1.0 at § 5.4 (Fig. 2).

> A **GPRS Support Node (GSN)** contains functionality required to support GPRS functionality for GERAN and/or UTRAN. In one PLMN, there may be more than one GSN.
>
> The **Gateway GPRS Support Node (GGSN)** is the node that is accessed by the packet data network due to evaluation of the PDP address. It contains routeing information for PS-attached users. The routeing information is used to tunnel N-PDUs to the MS's current point of attachment, i.e. the Serving GPRS Support Node. The GGSN may request location information from the HLR via the optional Gc interface. The GGSN is the first point of PDN interconnection with a PLMN supporting GPRS (i.e. the Gi reference point is supported by the GGSN). GGSN functionality is common for all types of RANs.
>
> The **Serving GPRS Support Node (SGSN)** is the node that is serving the MS. The SGSN supports GPRS for A/Gb mode (i.e. the Gb interface is supported by the SGSN) and/or Iu-mode (i.e. the Iu interface is supported by the SGSN). At PS attach, the SGSN

> establishes a mobility management context containing information pertaining to e.g. mobility and security for the MS. At PDP Context Activation, the SGSN establishes a PDP context, to be used for routeing purposes, with the GGSN that the subscriber will be using.
>
> The SGSN and GGSN functionalities may be combined in the same physical node, or they may reside in different physical nodes. The SGSN and the GGSN contain IP or other (operator's selection, e.g. ATM-SVC) routeing functionality, and they may be interconnected with IP routers. In Iu mode, the SGSN and RNC may be interconnected with one or more IP routers. When the SGSN and the GGSN are in different PLMNs, they are interconnected via the Gp interface. The Gp interface provides the functionality of the Gn interface, plus security functionality required for inter- PLMN communication. The security functionality is based on mutual agreements between operators.
>
> The SGSN may send location information to the MSC/VLR via the optional Gs interface. The SGSN may receive paging requests from the MSC/VLR via the Gs interface.
>
> The SGSN interfaces with the GSM-SCF for optional CAMEL control using Ge reference point. Depending on the result from the CAMEL interaction, the session and packet data transfer may proceed normally. Otherwise, interaction with the GSM-SCF continues as described in 3GPP TS 23.078 [8b]. Only the GSM-SCF interworking points are indicated in the signalling procedures in this specification.

3GPP TS 23.060 v5.1.0 at § 5.4.1.

(b) IP Transport in UMTS

105. Prior art 3G UMTS systems provided reliable Internet connectivity over a cellular connection. "3G can certainly cope with IP multimedia—at one level, it can be simply viewed as a non-IP access technology like PSTN dial-IP access or GSM circuit-switched data. For example, UMTS can be easily viewed as a Layer 2 network, since user IP packets are always encapsulated, and the headers are not used until the Internet gateway is reached." IP for 3G at 56-57.

106. Infrastructure-wise, UMTS allowed network elements implementing Universal Terrestrial Radio Access Network (UTRAN) functions (*e.g.*, Node B, RNC, and Management

Platform) to communicate over IP. This IP transport network is responsible for transporting user, control plane, data, and O&M (operations and maintenance) data between the network elements. *See, e.g.*, 3GPP TR 25.933 v.5.1.0 (6/2002) at 70. The following figure provides an example architecture for IP transport in UMTS.

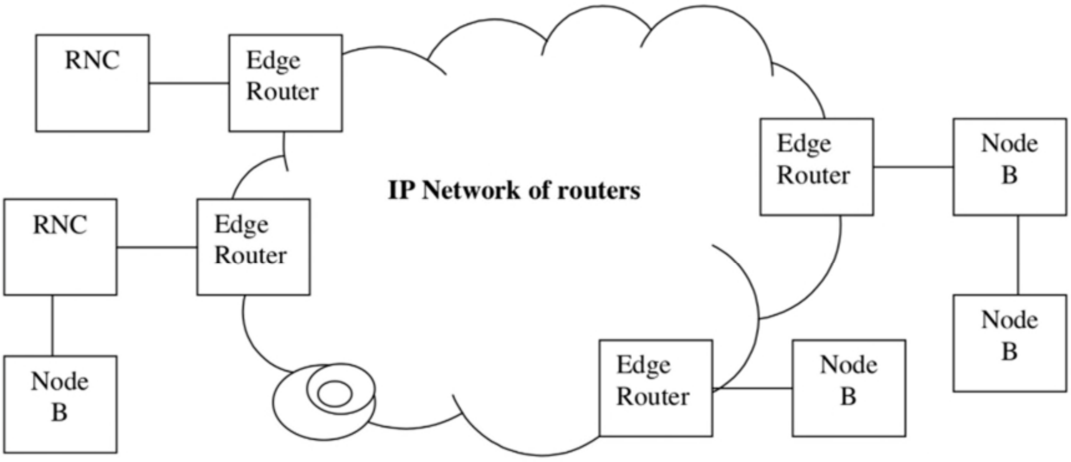


Figure 6-29: Example Architecture for IP Transport Network

Id. at 71 (Fig. 6-29).

107. The following figure illustrates the transport protocol stack for the user plane for UMTS and GPRS.

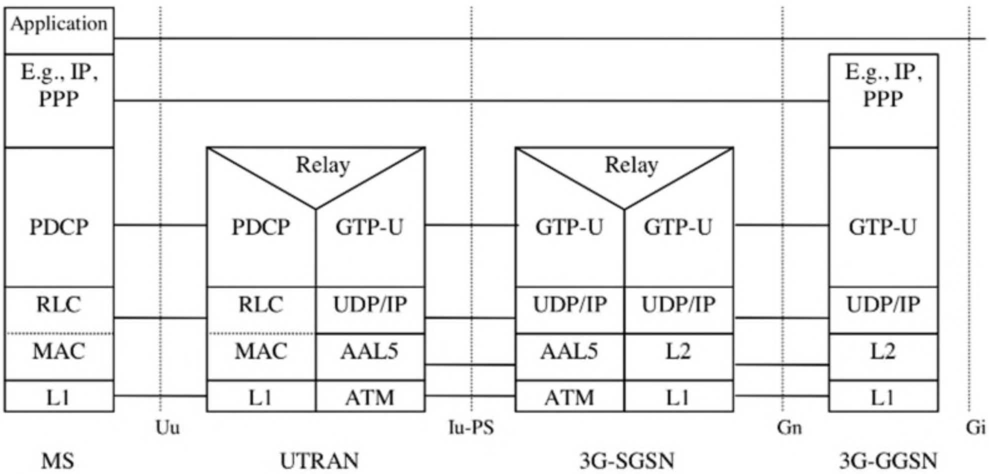


Figure 6: User Plane with UTRAN

3GPP 23.060 v.5.1.0 (3/2003) at 26 (Fig. 6). The "air interface" Uu provides IP connectivity between the mobile device (or UE) and the 3G-GGSN (gateway). The IP user traffic is encapsulated in the GTP-U tunnels and carried as IP packets within the IP transport between the UTRAN (from the RNC within the UTRAN) and the SGSN over the IU-PS interface. Similarly the Gn interface carries the user's IP packets from the SGSN to the GGSN, also encapsulated within the GTP tunneling protocol, and transported via IP packets. This prior art arrangement is similar to the GTP protocol use between the eNodeB to the SGW, and the GTP protocol between the SGW and PGW of LTE, which directly evolved from the prior art UMTS systems discussed herein. Additional details are provided in the following citations:

> From the terminal to the RNC IP packets are carried in PDCP packets. PDCP is Packet Data Convergence Protocol and provides either an acknowledged/ unacknowledged or transparent transfer service. This choice is related to the (backward) error correction that the underlying RLC (Radio Link Control) layer applies - more details of the functions of RLC can be found in the UTRAN section below Transparent means that no error correction is applied at Layer 2. The unacknowledged mode detects duplicate and erroneous packets but simply discards them, whereas in acknowledged mode, the RLC operates and resends missing frames (at Layer 2, packets are usually called frames, e.g. Ethernet frames). The choice of mode is based on the required QoS, resending lost or errored frames causes delay, and so the acknowledged mode is only used for applications that are delay sensitive. PDCP also performs a compression/decompression function - such as compressing TCP/IP headers.
>
> From the RNC to the SGSN IP packets are tunnelled using a tunnelling protocol called GTP - GPRS tunnelling protocol. Another GTP tunnel then runs from the SGSN to the GGSN, allowing a hierarchical mobility (SGSN changes will not happen often) and allowing lawful interception (phone tapping) at the SGSN. (IP for 3G at 42)
>
> A tunnelling protocol consists of a piece of software that take packets and wraps them within new packets such that the entire original packet - including the header - becomes the new payload: the original header is not used for routing/switching and is not read whilst encapsulated. A very good analogy is that if a person sends a

friend a letter to their home address, their mum puts it in a new envelope, addressed to their college address, and pops it back in the post. GTP in UMTS is more analogous to allowing several languages to be used to address the inner envelopes. Only the main post offices understand Chinese, so letters must be enclosed within a new envelope addressed in English to pass through the UK postal system. Using GPRS tunnelling protocol, UMTS can carry a number of different packets (such as IPv4, IPv6, PPP, and X25) over a common infrastructure. GTP packets are formed by adding a header to the underlying PDP packet - the format of this header is shown in Figure 2.11. After forming a GTP packet, it is sent using UDP over IP using the IP address of the tunnel end point, e.g. the GGSN for traffic sent from the SGGN to a external network. The most important header field is the tunnel id that identifies the GTP packets as belonging to a particular PDP context of a particular user (and therefore can be given the appropriate QoS). The Tunnel id is formed from combination of the IMSI and NSAPI - the IMSI uniquely identifying a terminal and the NSAPI being a number from 0 to 15 that identifies the PDP context or the secondary PDP context within a primary PDP context (Figure 2.12).

IP for 3G at 41-42.

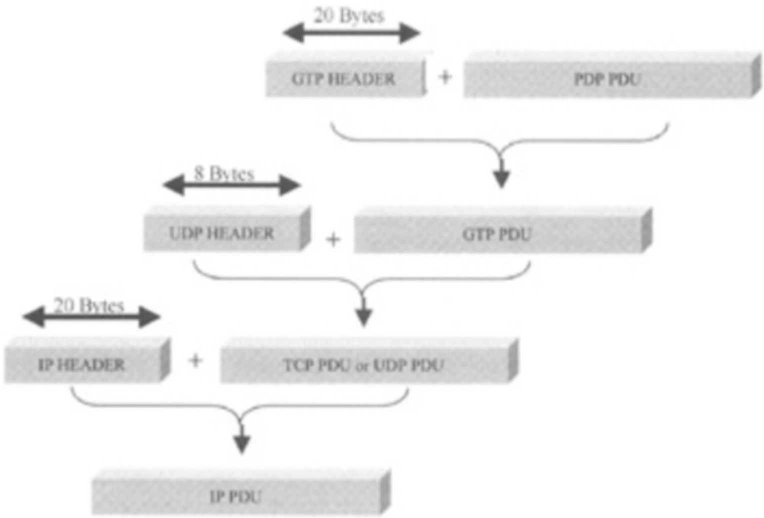


Figure 2.11: GTP-tunnelling.

Bits								
Octets	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
1	Version			PT	(*)	E	S	PN

	Bits							
Octets	8	7	6	5	4	3	2	1
2	Message Type							
3	Length (1st Octet)							
4	Length (2nd Octet)							
5	Tunnel Endpoint Identifier (1st Octet)							
6	Tunnel Endpoint Identifier (2nd Octet)							
7	Tunnel Endpoint Identifier (3rd Octet)							
8	Tunnel Endpoint Identifier (4th Octet)							
9	Sequence Number (1st Octet)							
10	Sequence Number (2nd Octet)							
11	N-PDU Number							
12	Next Extension Header Type							

Figure 2.12: GTP header format (and formation of packet).

Id. at 42-43 (Figs. 2.11 and 2.12).

108. The following diagram depicts the control plane protocols associated with UMTS/GPRS.

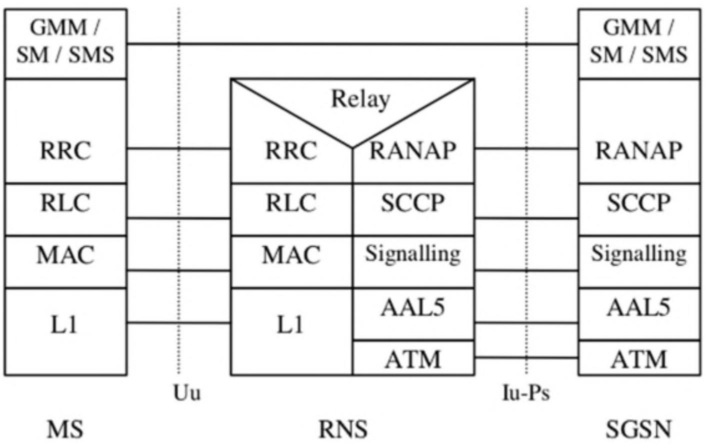


Figure 8: Control Plane MS - SGSN in Iu mode

3GPP TS 23.060 v.5.1.0 (3/2002) at § 5.6.3.2 (Fig. 8). Additional details regarding these protocols are provided in the following:

> The RLC (Radio Link Control) layer is responsible for setting up and tearing down RLC connections - each represents a different radio bearer (meaning that there is one radio bearer per PDP context or circuit). The RLC layer segments and reassembles data packets as well as providing backward error correction.
>
> The RLC is also responsible for ciphering and can perform flow control, i.e. the receiving end can request the transmitting end to slow down transmission to prevent, for example, buffer overflow. For data, the RLC terminates at the RNC - so RLC frames are carried to the node B over the radio interface and MAC layers and then on to the RNC on AAL2/ATM switched circuits (see below).
>
> The MAC layer is responsible for mapping logical channels (including data flows) into the transport channels provided by the physical layer…
>
> The MAC layer is also responsible for multiplexing/demultiplexing flows from the user on to transport channels (that are similar, but fewer in number to the logical channels, e.g. a BCH (Broadcast Channel carries the contents of the BCCH). The MAC also handles priority handling of flows from one user, i.e. allowing flows with higher priority QoS to have higher priority access to physical channels.
>
> The physical layer is responsible for transmission of data blocks: multiplexing of different transport channels (e.g. the P-CCPCH - Primary Common Control Physical CHannel carries the BCH), forward error correction (error coding) and error detection, spreading (with the CDMA code), and RF modulation.

IP for 3G at 46-47.

109. The following figures depicts how the IP transport operates for the Iub interface (between NodeB and RNC).

3GPP TR 25.933 version 5.1.0 Release 5 28 ETSI TR 125 933 V5.1.0 (2002-06)

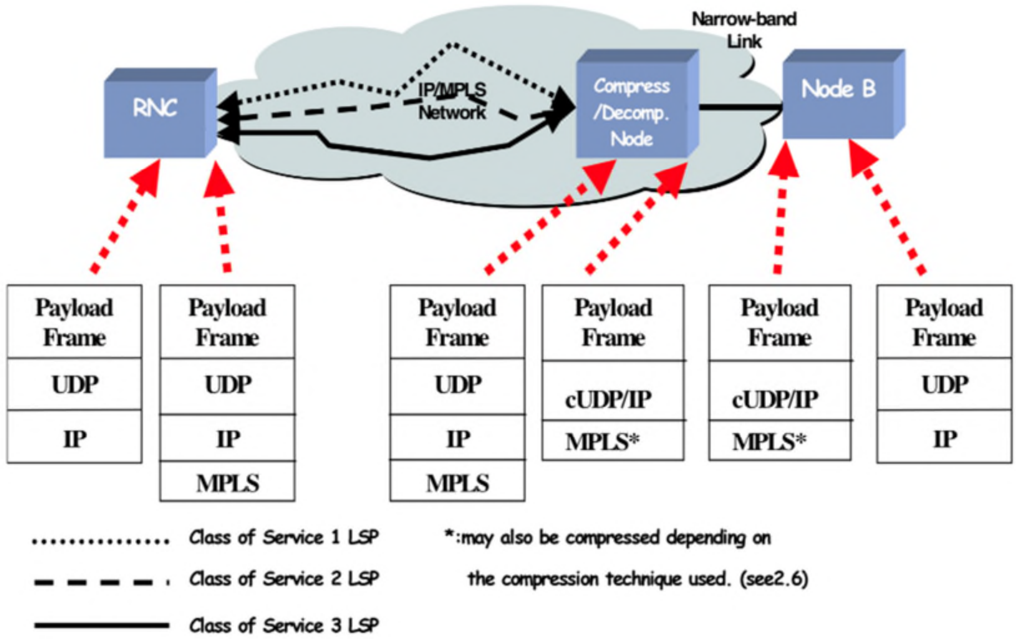


Figure 6-11: Protocol stacks at key nodes in the network for a MPLS-based transport solution

3GPP TR 25.933 v.5.1.0 (6/2002) at § 6.2.4.4 (Fig. 6-11).

110. The following citations describe the Iu interface between the RNC and SGSN.

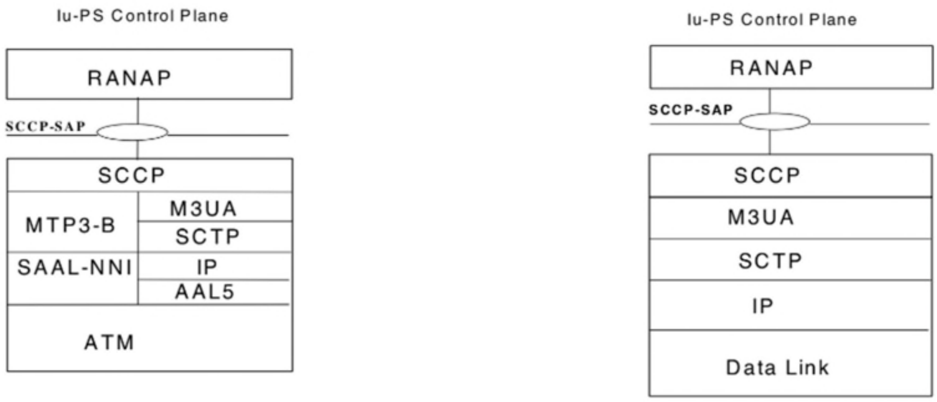
> The signalling across the I_u interface (from SGSN to RNC) is provided by RANAP - Radio Access Network Application Part. RANAP is responsible for:
>
> - Radio Access Bearer set-up, modification, and release.
> - Control of the UTRAN security mode.
> - Management of RNC relocation procedures.
> - Exchanging user information between the RNC and the Core Network.
> - Transport of mobility management and communication control information between the core network and the mobile [the so-called Non-Access Stratum (NAS) information - such as PDP context management - that does not concern the UTRAN].
> - Set-up of GTP tunnels between the SGSN and the RNC.
>
> From the RNC to the terminal, the Radio Resource Controller (RRC) (see Figure 2.14) sets up a signalling connection from the user's equipment (UE) to the RNC. This covers the assignment, re-

configuration and release of radio resources. The RRC also handles handover, cell re-selection, paging updates, and notifications.

IP for 3G at 52.

5.3.1 Protocol Stack for the PS Domain

The protocol stacks for the PS Domain is shown in figure 2. The standard allows operators to choose one out of three standardised protocol suites for transport of SCCP messages.



Protocol stacks for ATM transport options **Protocol stack for IP transport option**

Figure 2: SAP between RANAP and its transport for the Iu –IP domain

3GPP TS 25.412 v.5.0.0 (3/2002) at §5.3.1. Additionally, the Iu-PS interface in UMTS taught the use of IP transport on top of the AAL5/ATM physical layer, as prior art to the ’417 Patent. *See Id.* Additional details regarding the Iu-PS, Iu-CS, Iub and Iur IP transport interfaces can be found in 3GPP TS 25.401 v.5.3.0 (6/2002) and in 3GPP TS 25.214 v.5.1.0 (6/2002).

111. Furthermore, it should be noted that, as in LTE, the Uu over-the-air interface in UMTS is not IP-based for the control plane. To the extent Mobility Workx accuses the LTE control plane relating to the LTE Uu interface as infringing, the Uu interface of the prior art UMTS Release 5 system teaches this same functionality for the control plane.

(c) Quality of Service Architecture

112. The following figure describes the UMTS quality of service (QoS) architecture, with “bearers” being terminated within different nodes of the network. A “bearer” is a term for a

QoS guaranteed circuit or QoS treatment of packets. *See* IP for 3G at 39. For example the "end to end service" is from the mobile device's Terminal Equipment (TE) to the TE of an external network.

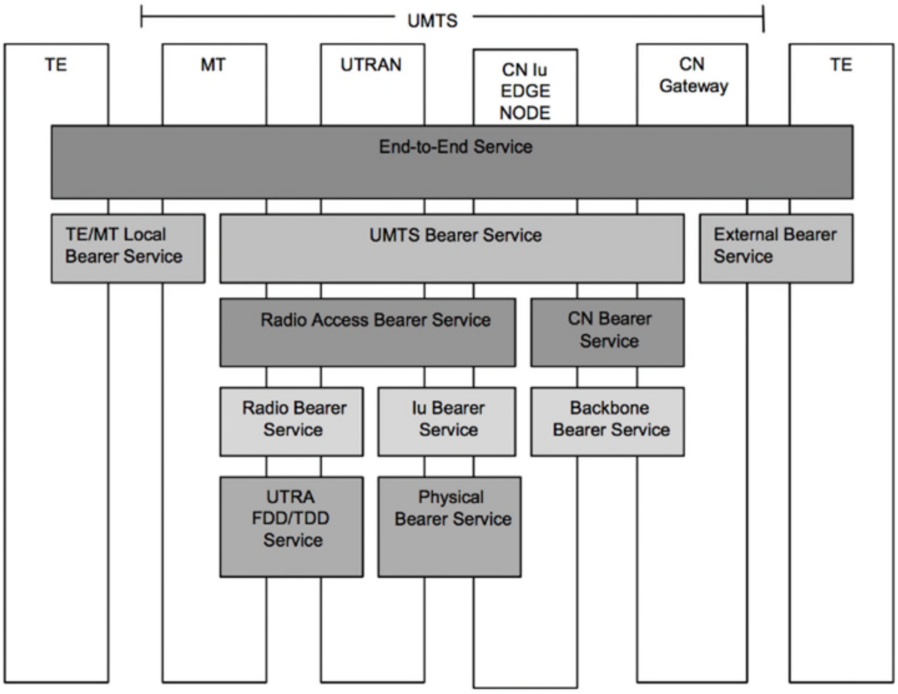


Figure 1: UMTS QoS Architecture

3GPP TS 23.107 v. 5.5.0 (6/2002) at 10 (Fig. 1).

113. In UMTS, there are classes to define of quality of services treatment:

> Conversational and streaming classes are intended for time-sensitive flows - conversational for delay-sensitive traffic such as VoIP (voice over IP). In the case of streaming traffic - such as watching a video broadcast, say - much larger buffering is possible, and so delays can be relaxed and greater error protection provided by error correction techniques that repeat lost packet fragments but add to delays. Interactive and background classes are for bursty, Internet-style, traffic.

IP for 3G at 40.

Table 1: UMTS QoS classes

Traffic class	Conversational class conversational RT	Streaming class streaming RT	Interactive class Interactive best effort	Background Background best effort
Fundamental characteristics	- Preserve time relation (variation) between information entities of the stream Conversational pattern (stringent and low delay)	- Preserve time relation (variation) between information entities of the stream	- Request response pattern - Preserve payload content	- Destination is not expecting the data within a certain time - Preserve payload content
Example of the application	- voice	- streaming video	- Web browsing	- background download of emails

3GPP TS 23.107 (6/2002) v.5.5.0 at § 6.3.4 (Table 1).

4. Overview of Handover Procedures in Prior Art Cellular Networks

114. By July of 2003, numerous 2G, 2.5G and 3G cellular networks had been standardized and implemented throughout the world, including GSM (2G), GPRS (2.5G), CDMA (2G and 3G), and UMTS (3G) cellular networks. In particular, the link layer handover procedures had been standardized to permit network-initiated and mobile-assisted handovers to occur automatically. The coverage of a typical base station in the conventional cellular networks was relatively large (approximately 1.5 kilometers in diameter or more) compared to the diameter of a typical Wi-Fi network access point's coverage area (on the order of 100 meters outdoors and 20 meters indoors). Moreover, the time to complete a link layer hard handover (interference handover for example) from one UMTS base station (eNodeB) to another in the same cellular network was generally around 100 milliseconds. *See* Sauter, "From GSM to LTE-Advanced" ("Sauter") at 184 ("The interruption of the data stream during this operation is usually quite short and takes about 100 milliseconds on average, as the network is already prepared for the new connection."). The 3GPP requirements for UMTS hard handover are defined in §5.2.2.1 (Hard handover delay) and §5.2.2 (Interruption time) in 3GPP TS 25.133, with specific examples of test cases provided in Section A.5.2 (requiring less than 110 ms for an intra-frequency hard handover (see A.5.2.1.2) and

less than 140 ms for an inter-frequency hard handover (*see* A.5.2.2.2)). Thus, within a particular cellular network, the setting up time (or handover time) was much smaller than the typical dwell time in a cell, even for fast moving vehicles. For example, at 200 km/h, the dwell time in a 1.5 km cell would be 27 seconds. When handovers occurred within these conventional cellular networks, the mobile node did not need to change its IP address using any mobile internet protocol.

115. In conventional cellular systems, as a mobile node moved from one coverage area towards another, the mobile node would measure the strengths of signals received from the base station in its current cell, as well as the strength of signals received from base station(s) in adjacent cell(s). A comparison of signal strength from different base stations was made such that, if it was determined that the signal strength of an adjacent cell reached an acceptable level (while the signal strength of the current base station is below a threshold) and that the adjacent cell had the capacity to take over the communication, the system would begin the handover registration process to transfer the connection to the adjacent base station.

116. The following table provides examples of several prior art wireless communication systems and identifies whether handovers in those systems were initiated by the mobile device or by the network.

Technology	**Wireless Category**	**type of handoff / handover**
Wi-Fi (IEEE 802.11)	Wireless LAN	Mobile Initiated
GSM	2.5G (3GPP)	Network Initiated /Mobile Assisted
CDMA (IS-95)	2.5G	Network Initiated /Mobile Assisted
CDMA2000	3G	Network Initiated /Mobile Assisted
W-CDMA	3G (3GPP)	Network Initiated /Mobile Assisted

117. The prior art 3GPP evolution path of standards (leading to LTE) were all network-initiated handovers with mobile assistance (that is, the network determines when a handover should occur), just like the accused LTE system. Thus, each network "reacted" to the conditions the mobile devices reported to the networks while within the coverage areas of both the current

and target base stations, in contrast to the "preemptive" handovers described in the '417 Patent that would be initiated before the mobile node arrived in the coverage area of the next base station.

(a) Handover in GSM / GPRS

118. Like the handover processes in UMTS and LTE, the GSM handover process is based upon (at least in part) measurements made in the mobile station that are reported to the network (*i.e.*, mobile assisted). The network would then make the handover decision (*i.e.*, network-initiated / network-controlled). Also like the UMTS and LTE handover processes, the GSM handover process is composed of two phases called "handover preparation" and "handover execution."

> "A handover is the process by which an MS relinquishes its connection with one BTS while establishing a new connection with another BTS while ensuring that an existing call is maintained. Handovers are also performed to decrease interference, or to relieve traffic congestion. Although the GSM specifications provide an example handover decision algorithm based on radio criteria, these solutions are not mandatory and the equipment manufacturer is free to implement its own algorithms. The complete handover process may be sub-divided into two distinct phases, preparation and execution."
>
> **2.4.4.1 Handover preparation**
>
> The decision to perform a handover and the identification of the most suitable new BTS is based on several different measurements, performed both at the MS and at the BTS. It is also based on a number of static parameters and the distribution of the traffic load within the network…
>
> **2.4.4.2 Handover execution**
>
> Once the decision has been taken to initiate a handover and the most suitable new cell has been identified, the MS and network enter the handover execution phase whereby the connection with the old BTS is relinquished and the connection with the new BTS is established…
>
> An MS is completely unaware of the impending handover until it receives the handover command message.

Steel at 135-40.

119. There are different types of handovers in GSM/GRPS. The following figure depicts several examples, including: handovers between base transceiver stations (BTS) under the same base station controller (BSC) (called intra-BSC handover); handovers between BSCs under the same mobile switching center (MSC) (called inter-BSC / intra-MSC handover); and handovers between MSCs (inter-MSC handover).

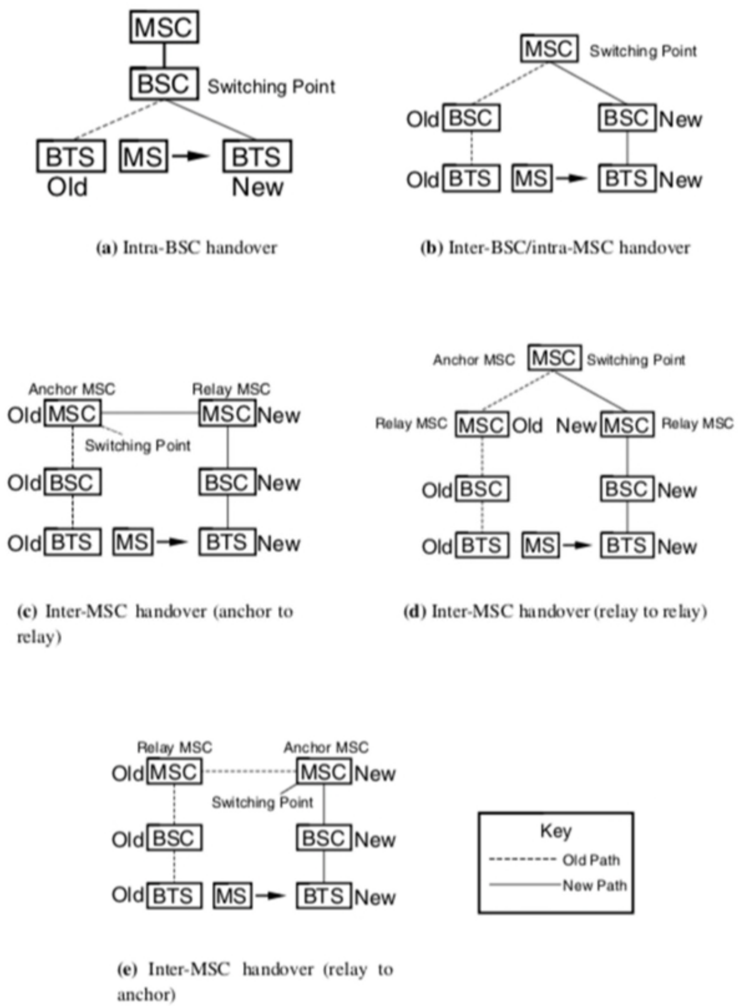


Figure 2.24: The different types of handover in GSM.

Id. at 141.

120. Additionally, within 2G GSM/GPRS, there are also inter/intra-SGSN handovers that occur in conjunction with inter-BSC handovers for packet switched services. The following provides details related to the GSM/GPRS protocols, and network elements.

> ***GPRS transmission plane***
>
> This is a layered protocol structure enabling user information transfer and associated control procedures such as flow control, error detection, error correction and error recovery. The GPRS transmission plane is shown in Figure 6.3 [18, 19]. We observe in Figures 6.2 and 6.3 the entities MS, BSS (namely BTS connected via the Abis to the BSC), SGSN and the GGSN; together with the interfaces Um, Gb, Gn and Gi. From the transmission plane we observe that at the highest level the application is leaving the network via Gi. The GPRS tunnelling protocol (GTP) tunnels user data and signalling between GPRS support nodes, SGSN and GGSN, in the backbone network. The transport control protocol (TCP) carries the GPRS tunnelling protocol (GTP) data units (PDUs) in the GPRS backbone network for protocols that need a reliable data link, such as X.25. The user datagram protocol (UDP) conveys GTP PDUs for protocols, such as Internet protocol (IP) that do not require reliable links. The TCP provides flow control and protection against lost and corrupted GTP PDUs. The GPRS backbone network protocol is IP, and is used for routing user data and signalling.

Id. at 414-15.

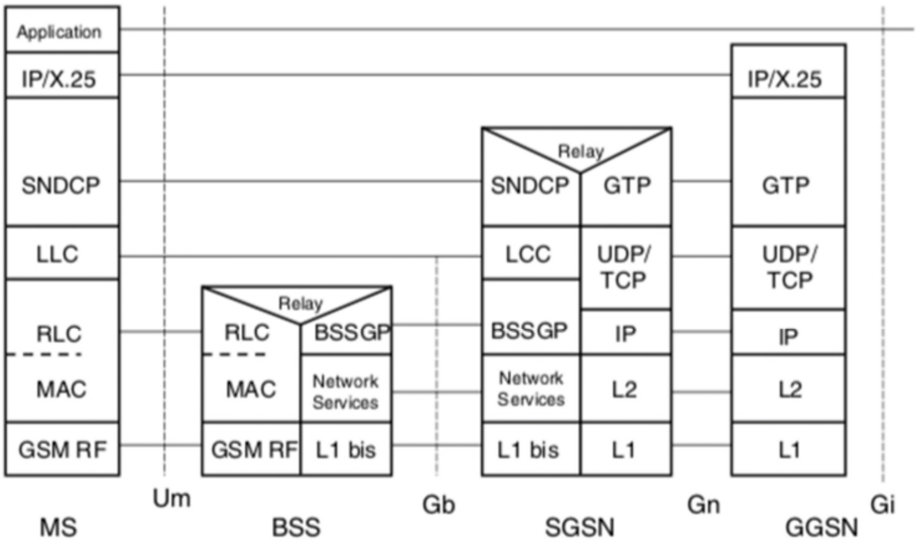


Figure 6.3: GPRS transmission plane [18–20].

Id. at 416 (Fig. 6.3).

> ***Radio resource management functions*** Allocation and maintenance of radio communication channels are provided by these functions. The GSM radio resources are dynamically shared between the circuit mode and GPRS. The GPRS radio resource management is concerned with the allocation and release of timeslots for a GPRS channel; monitoring GPRS channel utilisation; congestion control; and the distribution of GPRS channel configuration information that is broadcast on the common control channels…
>
> ***Packet data logical channels*** Although circuit switched and GPRS services use the same physical channels, they have different logical channels. The physical channel dedicated to packet data is called a packet data channel (PDCH). The logical channels for common control signalling for packet data are carried by the packet common control channel (PCCCH), and there is also the packet random access channel (PRACH), an up-link-only channel used by MSs to initiate data or signalling packet transmission.

Id. at 418.

(b) Handover in UMTS (Release 99-Release 5)

121. Like the BSC in GSM, the radio network controller (RNC) in UMTS configures measurements in the user equipment (UEs) used in the handover process.

Table 3.2 RRC measurement types and Event-ID groups.

Measurement type	Event-ID group	Typical tasks
Intrafrequency measurement	el...	Triggers softer or soft handover and intrafrequency hard handover if necessary
Interfrequency measurement	e2...	Triggers interfrequency hard handover if necessary
Inter-RAT measurement	e3...	Triggers handover from UTRAN (to, e.g., GSM) if necessary
Traffic volume measurement	e4...	Triggers change of RRC State while PDP context stays active (channel type switching)
Quality reporting	e5...	Informs SRNC that a predefined number of CRC errors is exceeded on UE side
UE internal measurement	e6...	Delivers information about UE Tx Power (e.g. if maximum Tx Power is reached)
UE positioning reporting (3GPP Rel. 4 and higher)	e7...	Informs network about problems with positioning accuracy (e.g. if position of UE is changing too often/ too fast to be reported)

Kreher et al., "UMTS Signaling: UMTS Interfaces, Protocols, Message Flows and Procedures Analyzed and Explained" (2007) ("Kreher") at 240 (Table 3.2).

> **3.7.3 Measurement Initiation for Intrafrequency Measurement**
>
> There are two different ways to initiate RRC measurement (Figure 3.39). The first is that UE reads SIB 11 and/or 12 from the Broadcast Channel of the current cell identified by a primary scrambling code that is also visible in the RRC Connection Setup message. The second way is that the SRNC sends an RRC Measurement Control message to the UE after successful establishment of the RRC connection.
>
> It is possible that several RRC Measurement Control messages are sent according to the different types of RRC measurement task. Also cell information lists (neighbor cell lists) and event criteria lists may be sent in separate messages. For instance, the first RRC Measurement Control message contains the Intrafrequency Cell Info List, and the second one the Event Criteria List with activated trigger conditions. In such a case, both messages may have different Measurement ID values and different RRC Transaction IDs.

The RRC Measurement Control messages are sent on a DCCH in downlink direction. A measurement identity is used as the setting identifier and will be used later in measurement reports related to these settings.

In the case of intrafrequency measurement, an intrafrequency cell information list (neighbor cell list) is sent to the UE. It contains the primary scrambling code (PScrCd) of cells to be measured and assigns an appropriate Intrafrequency Cell ID to each cell of the list. Then the measurement quantity is defined – in the example, the Ec/No relation value of the primary CPICH signal of the listed FDD cells.

Kreher at 240.

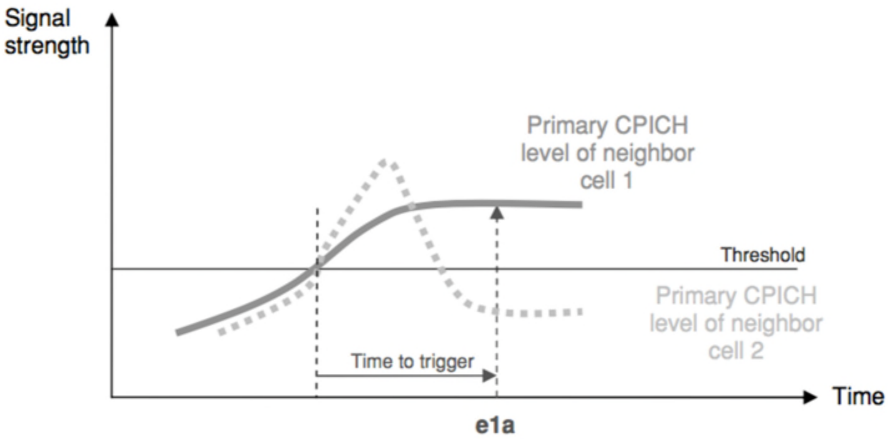


Figure 3.43 Time-to-trigger and influence on event report.

Id. at 244.

122. The following figure provides the configuration of measurements of a UE by the RNC.

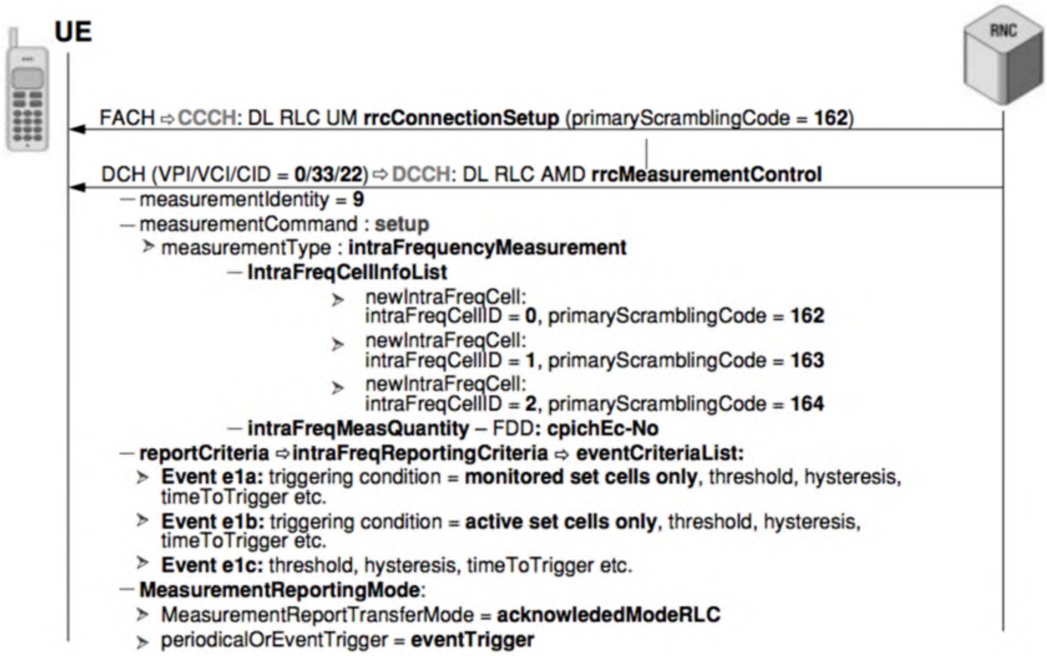


Figure 3.39 Initiation of RRC intrafrequency measurement.

Id. at 241.

123. In UMTS handover can occur between:

- Between NodeBs of the same RNC (intra-RNC handover);
- Between NodeBs of different RNCs (inter-RNC handover, as a hard handover); and
- Between RNCs of different SGSNs (inter-RNC hard handover with SGSN relocation).

124. UMTS supports both soft handover (in which the UE makes RRC connections to more than one NodeB at the same time) and hard handovers (in which a mobile must disconnect from the source NodeB before connecting to a target NodeB).

125. Like LTE, the UMTS network makes the decision to initiate a handover based, at least in part, upon UE's receiver signal level measurements of adjacent cells, which the UE reports to the RNC (within the RNS). Prior to commanding the UE to execute the handover, the network directs the target RNC to reserve resources if RNC relocation is to be performed. Likewise, if a SGSN relocation is to be performed, a similar process is followed. In UMTS, each NodeB can

broadcast neighbor lists to inform the UEs of the presence of neighboring NodeBs. Furthermore, the serving RNC will configure the UE to perform signal level measurements of the neighboring NodeBs.

(i) NodeBs of the Same RNC (Intra-RNC Handover)

126. As illustrated below, intra-RNC handovers involve handing over from one NodeB to another, where both NodeBs belong to the same RNC. The UE is currently moving in an area covered by both the serving NodeB and the target NodeB, where the signal level of the serving NodeB is deteriorating while the signal level of the target NodeB becomes better. "Based on the measurement reports sent by the UE the SRNC will decide in the first step to activate inter-frequency measurements using compressed mode. In the second step the handover decision will be made and the handover is executed." Kreher at 291.

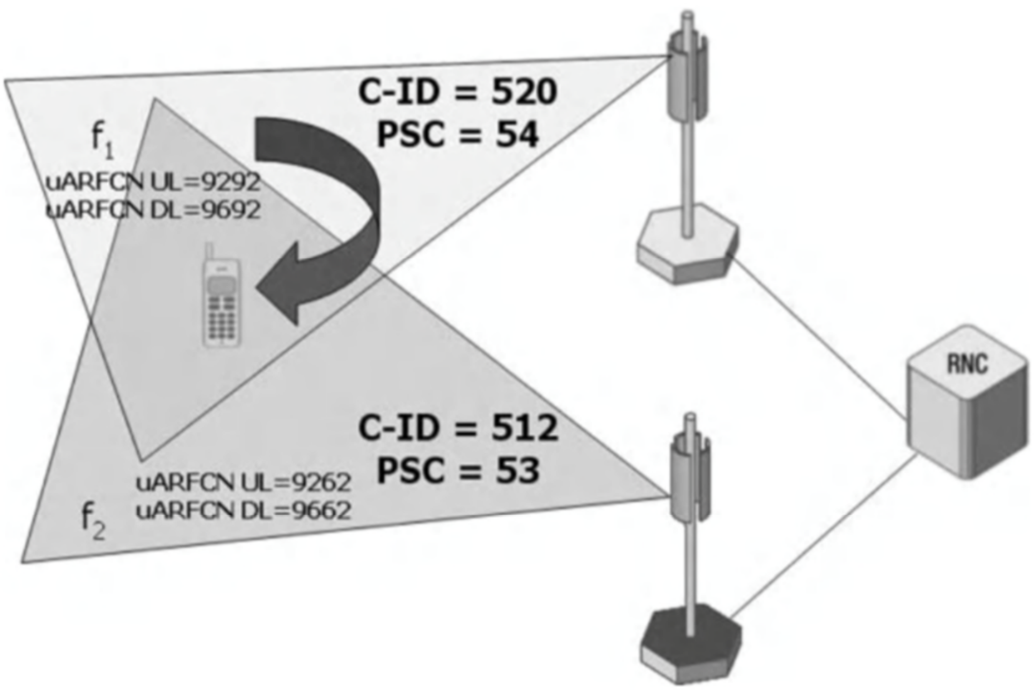


Figure 3.88 FDD interfrequency inter-Node B hard handover overview.

Id. (Fig. 3.88).

127. The RRC message flow for the above hard handover is depicted in the following figures:

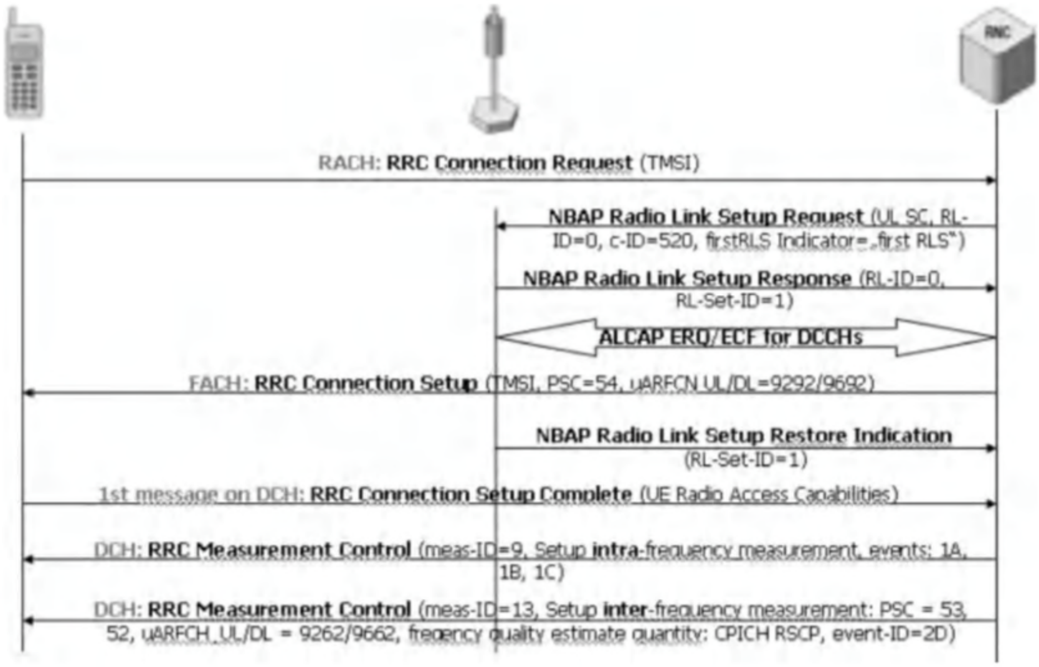


Figure 3.89 FDD interfrequency inter-Node B hard handover call flow 1/3.

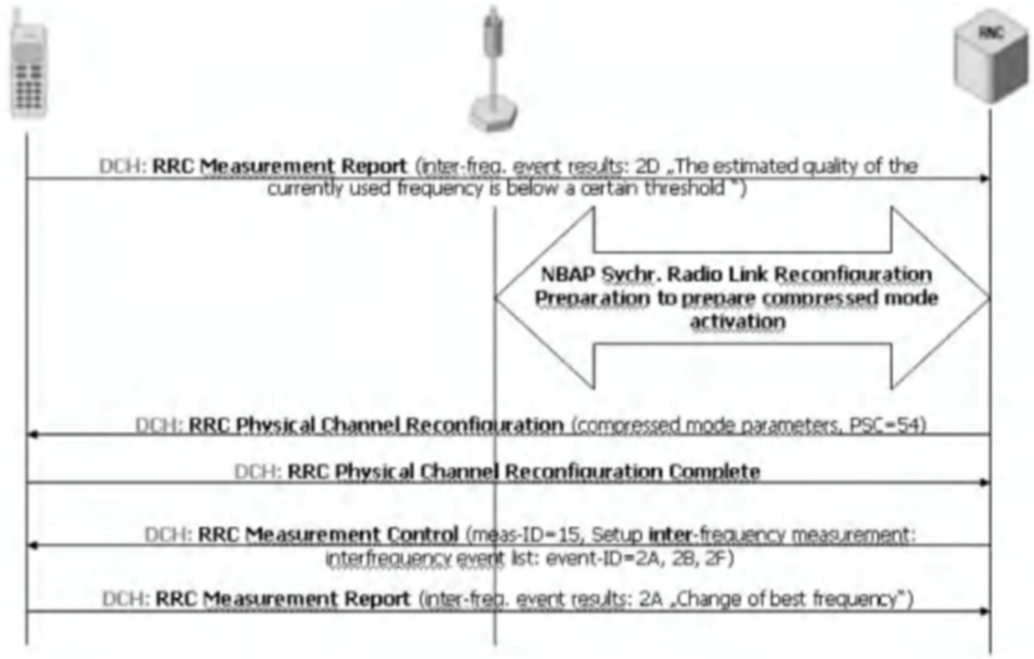


Figure 3.90 FDD interfrequency inter-Node B hard handover call flow 2/3.

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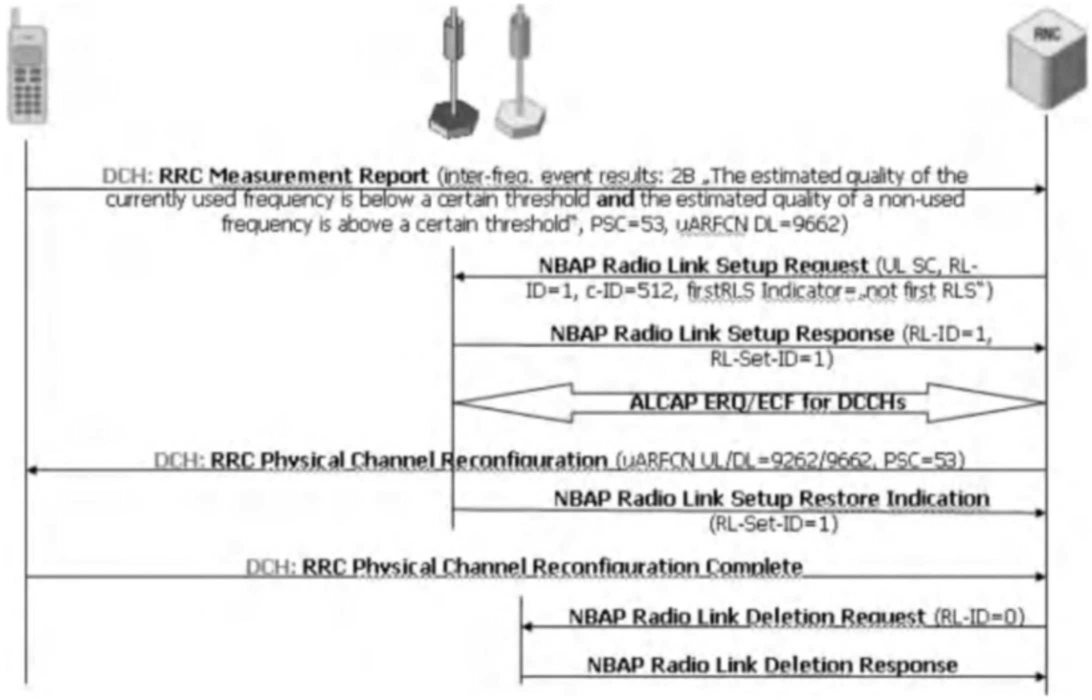


Figure 3.91 FDD interfrequency inter-Node B hard handover call flow 3/3.

(ii) NodeBs of Different RNCs (Inter-RNC Handover as a Hard Handover)

128. Inter-RNC handover, also called SRNS relocation, is used to relocate the serving RNS functionality from one RNS to another. The diagram below shows the procedure involved for an intra-MSC SRNS relocation, where the 3G_MSC supports the Iu interface and controls the call, the mobility management and the radio resources before, during, and after an Intra-MSC handover. *See* 3GPP TS 23.009 v.5.1.0 at §§ 3.1, 4.1.1, 6.2.3 (Fig. 11).

3GPP TS 23.009 version 5.1.0 Release 5 29 ETSI TS 123 009 V5.1.0 (2002-06)

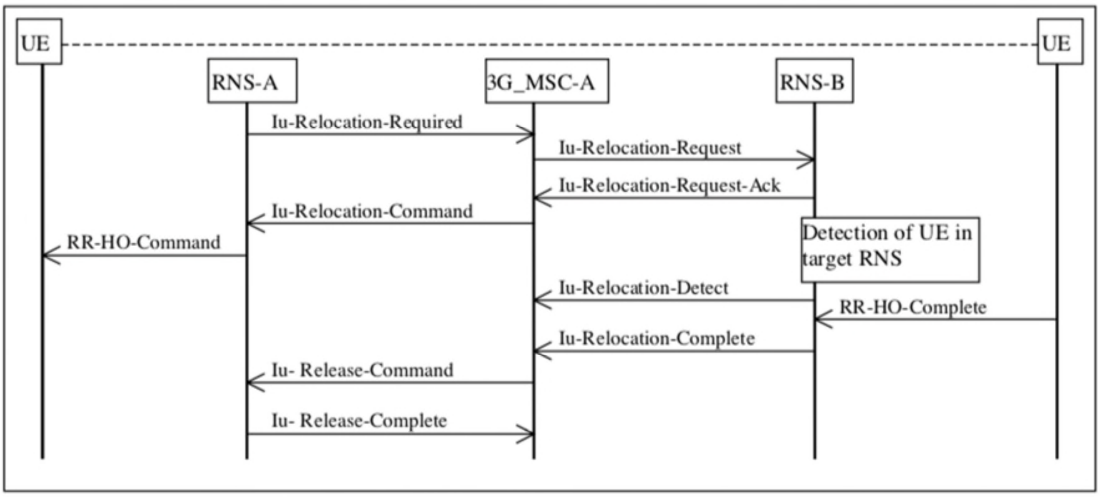


Figure 11 Basic intra-3G_MSC SRNS Relocation Procedure combined with hard change of radio resources (Hard Handover with switch in the Core Network)

> If the UE is involved in the relocation procedure it always means that a (backward) hard handover controlled by the old SRNC (RNC 1) is performed. As shown in Figure 5.54 this relocation procedure may once again have impact on all ongoing signaling and user traffic exchanged between the UE and the CS/PS core network domains. When RNC 1 decides to perform hard handover and change of the SRNC in one step (1) , a RANAP Relocation Required message will be sent to participating core network elements MSC and/or SGSN (2) , which then will set up new Iu signaling connections and Iu bearers toward RNC 2 (3) . After the handover has been performed successfully signaling connections and user plane transport bearers on Iu interfaces between core network elements and RNC 1 can be released (4).

Kreher at 426.

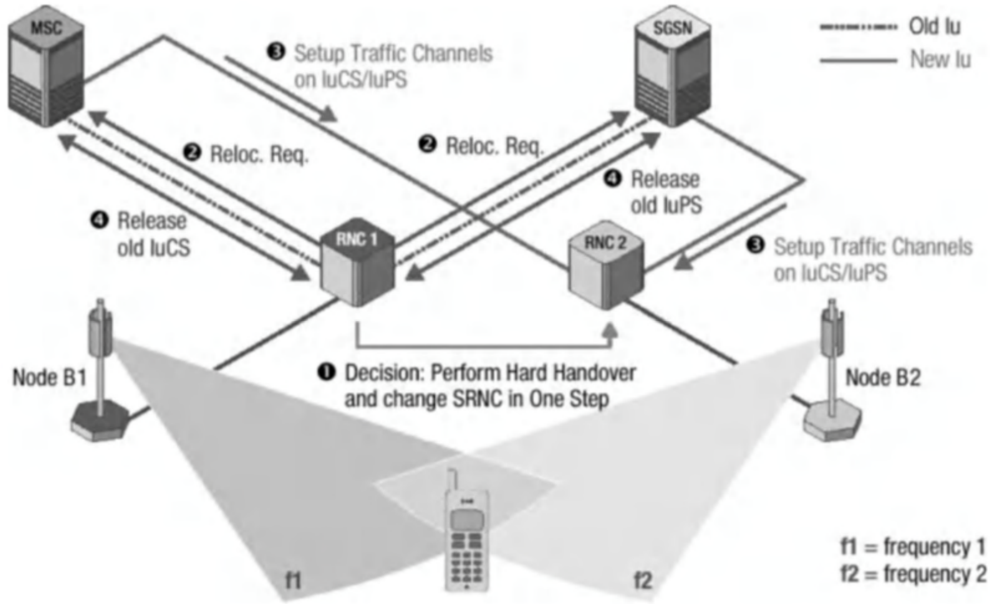


Figure 5.54 SRNS relocation (UE involved) principle.

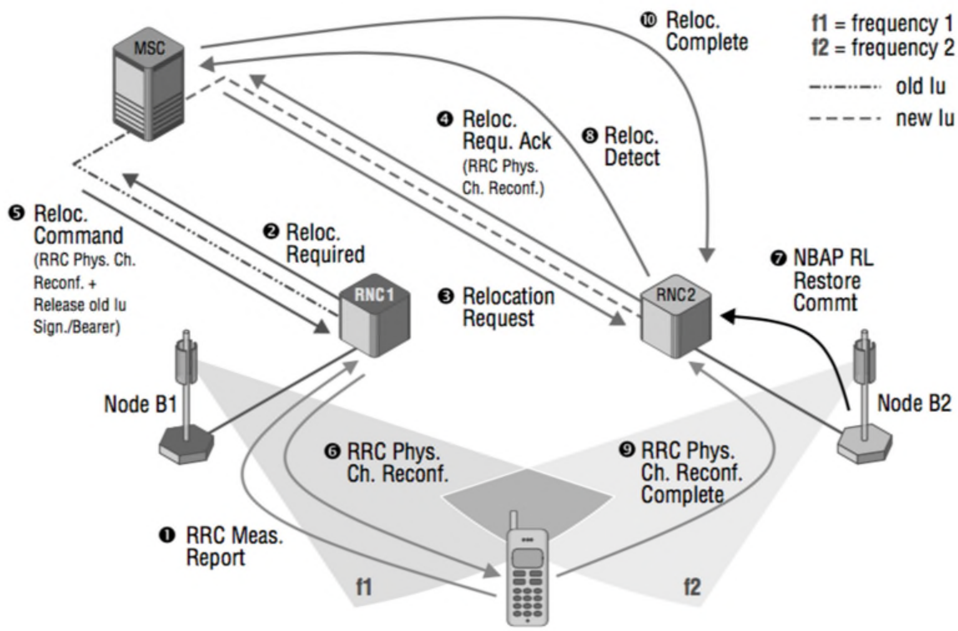


Figure 5.55 SRNS relocation (UE involved) procedure overview.

Id. at 427-28.

(iii) Inter-RNC Hard Handover with SGSN Relocation

129. "If a user moves within the coverage area of a base station (and RNC) served by a different SGSN, this requires the highest level of mobility management—the Inter-SGSN/MSC SRNS relocation." IP for 3G at 49. A UE-involved inter-RNC hard handover with SGSN relocation procedure is used to move the RAN-to-CN connection point at the RAN side from the source SRNC to the target RNC, while performing a hard handover decided by the RAN. In the procedure, the Iu links are relocated. 3GPP TS 23.060 v.5.1.0 (3/2002) at § 6.9.2.2.2. The procedure is illustrated in the figures below.

3GPP TS 23.060 version 5.1.0 Release 5 79 ETSI TS 123 060 V5.1.0 (2002-03)

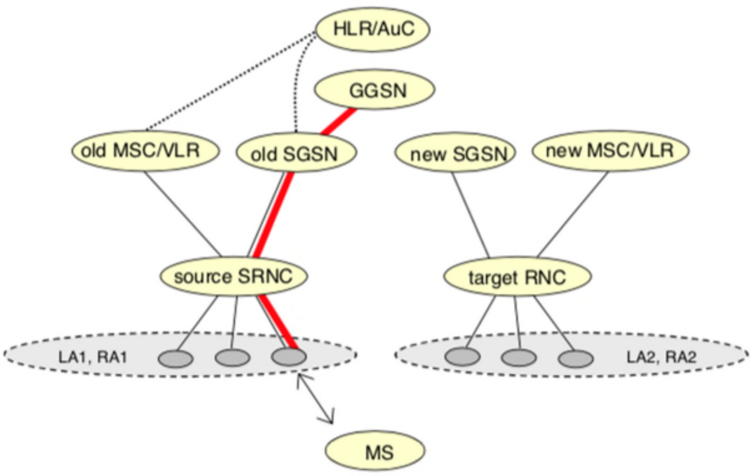


Figure 40: Before Combined Hard Handover and SRNS Relocation and Routeing Area Update

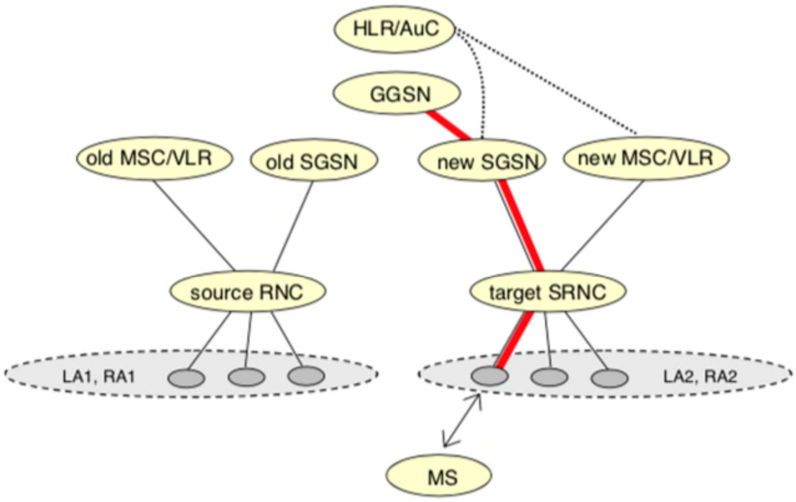


Figure 41: After Combined Hard Handover and SRNS Relocation and Routeing Area Update

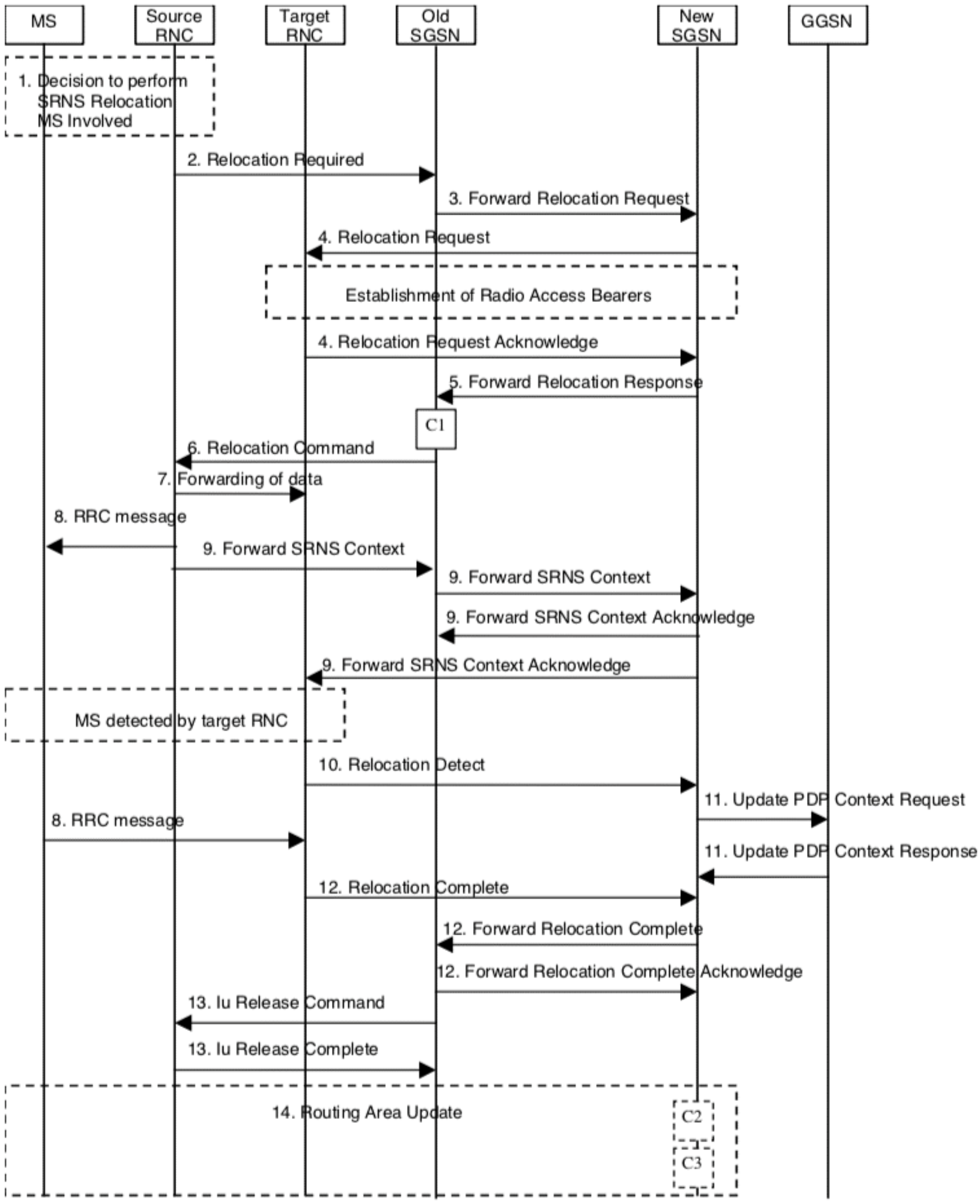


Figure 42: Combined Hard Handover and SRNS Relocation Procedure

Id. at § 6.9.2.2.2 (Figs. 40-42).

130. The following citation provides more details regarding the initial steps of the combined hard handover and SRNS relocation procedure:

> 1) Based on measurement results and knowledge of the RAN topology, the source SRNC decides to initiate a combined hard handover and SRNS relocation. At this point both uplink and

downlink user data flows via the following tunnel(s): Radio Bearer between the MS and the source SRNC (no drift RNC available); GTP-U tunnel(s) between the source SRNC and the old SGSN; GTP-U tunnel(s) between the old SGSN and the GGSN.

2) The source SRNC sends a Relocation Required message (Relocation Type, Cause, Source ID, Target ID, Source RNC To Target RNC Transparent Container) to the old SGSN. The source SRNC shall set Relocation Type to "UE Involved". Source RNC To Target RNC Transparent Container includes the necessary information for relocation co-ordination, security functionality and RRC protocol context information (including MS Capabilities).

3) The old SGSN determines from the Target ID if the SRNS relocation is intra-SGSN SRNS relocation or inter-SGSN SRNS relocation. In case of inter-SGSN SRNS relocation the old SGSN initiates the relocation resource allocation procedure by sending a Forward Relocation Request message (IMSI, Tunnel Endpoint Identifier Signalling, MM Context, PDP Context, Target Identification, RAN Transparent Container, RANAP Cause) to the new SGSN. For relocation to an area where Intra Domain Connection of RAN Nodes to Multiple CN Nodes is used, the old SGSN may – if it provides Intra Domain Connection of RAN Nodes to Multiple CN Nodes -have multiple target SGSNs for each relocation target in a pool area, in which case the old SGSN will select one of them to become the new SGSN, as specified in 3GPP TS 23.236 [73]. PDP context contains GGSN Address for User Plane and Uplink TEID for Data (to this GGSN Address and Uplink TEID for Data, the old SGSN and the new SGSN send uplink packets). At the same time a timer is started on the MM and PDP contexts in the old SGSN (see Routeing Area Update procedure in subclause "Location Management Procedures (Iu mode)"). The Forward Relocation Request message is applicable only in case of inter-SGSN SRNS relocation.

4) The new SGSN sends a Relocation Request message (Permanent NAS UE Identity, Cause, CN Domain Indicator, Source RNC To Target RNC Transparent Container, RAB To Be Setup) to the target RNC. For each RAB requested to be established, RABs To Be Setup shall contain information such as RAB ID, RAB parameters, Transport Layer Address, and Iu Transport Association. The RAB ID information element contains the NSAPI value, and the RAB parameters information element gives the QoS profile. The Transport Layer Address is the SGSN Address for user data, and the Iu Transport Association corresponds to the uplink Tunnel Endpoint Identifier Data.

Id. at § 6.9.2.2.2.

5. Overview of IP Mobility

131. IP mobility was already a broadly researched topic at the time of the filing of the ’417 Patent. This section provides some discussion related to what one of ordinary skill in the art would have known at that time regarding IP mobility.

132. “The challenge of ‘IP mobility’ is to deliver IP-based applications to mobile terminals/users, even though, traditionally, IP-protocols have been designed with the assumption that they are stationary.” IP for 3G at 116. In broad terms, IP mobility was viewed as being addressable at different layers of the protocol stack: (i) at layer 2, hidden from the IP layer; (ii) at the application layer, above the IP layer; or (iii) at the IP layer itself. *See id.* at 117-19.

133. As discussed previously, IP mobility was addressed in GSM/GPRS and UMTS using layer 2 tunnels (*i.e.*, option 1 above). This approach addressed IP “micro-mobility,” which is mobility within the same access network (*e.g.*, UTRAN). Additionally, UMTS Release 5 standardized the IP Multimedia Subsystem (IMS) to support Voice over IP (VoIP), among other multimedia applications, and addressed IP mobility at the application layer using the SIP protocol (*i.e.*, option 3 above). As I will discuss in more detail below, UMTS also addressed IP “macro mobility,” which refers to mobility across different access networks, using Mobile IP integrated with the GGSN as a foreign agent and a home agent residing within a home access network.

> Another example is where a GSM user dials into their ISP, with PPP used to give an application level connectivity to their e-mail or the Internet. Mobility is handled entirely by the GSM protocol suite and IP stops at the ISP - so as far as IP is concerned, **the GSM network looks like a Layer 2. Clearly, this solution does work and indeed has been very successful.**

IP for 3G at 118.

134. As for addressing IP mobility at the IP layer, the following table provides a list of different IP mobility solutions that were available at least as of 2002:

Table 5.1: Different mobility solutions map between different identities and locators

	Identifier	Locator
DNS www portal SIP	Web site name E.g. e-mail address + password SIP URL	IP address Current terminal's IP address e.g. instant messaging name, e-mail address, phone number
Mobile IP	Home IP address	Co-located care-of address (or foreign agent care-of address in mobile IPv4)
Hierarchical Mobile IPv6	Regional care-of address	On-link care-of address
BCMP	Globally routable address	Current access router
Cellular IP	V4: mobile IP home address V6: co-located care-of address	Per-host entry at each router
Hawaii	Co-located care-of address	Per-host entry at each router
MER-TORA	Globally routable address	Prefix-based routing + per-host entries at some routers as mobile moves
WIP	Co-located care-of address	Prefix-based routing + per-host entries at some routers as mobile moves
IAPP	MAC address	Layer 2 switch's output port

Id. at 119-20.

(a) Macro-Mobility vs. Micro-Mobility

135. This section discusses then prior art concepts of micro and macro mobility, and generally defines them as the change of access points within a given access network (micro-mobility), versus changing access points between two different access networks (macro-mobility).

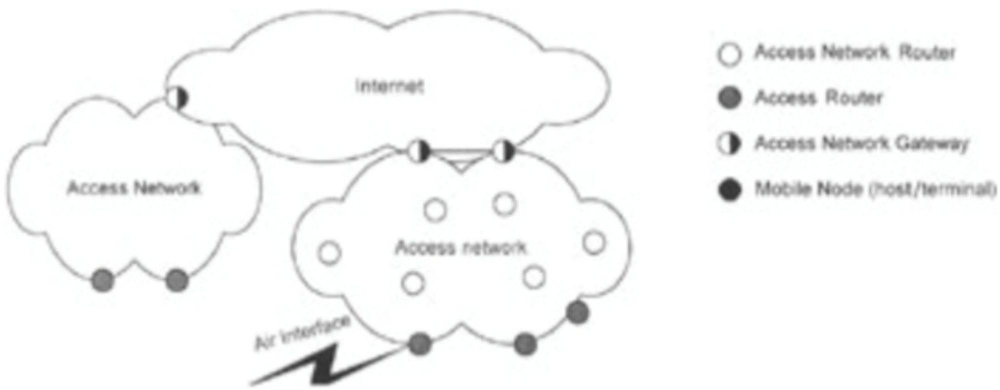


Figure 5.2: Terminology for Access Network.

IP for 3G at 123.

136. As shown below, the IETF Mobile IP standard (RFC 2002) used similar terminology, and even states that a link layer (layer 2) solution may be preferable for micro-mobility between wireless transceivers covering small areas. RFC 2002 was published in October 1996, while GPRS (an example of such link layer solution) was first standardized and published in the same time frame as GSM 03.60 by ETSI.

> Mobile IP is intended to enable nodes to move from one IP subnet to another. It is just as suitable for mobility across media as it is for mobility across heterogeneous media. That is, Mobile IP facilitates node movement from one Ethernet segment to another as well as it accommodates node movement from an Ethernet segment to a wireless LAN, as long as the mobile node's IP address remains the same after such a movement.
>
> One can think of Mobile IP as solving the “macro” mobility management problem. It is less well suited for more “micro” mobility management applications -- for example, handoff amongst wireless transceivers, each of which covers only a very small

geographic area. As long as node movement does not occur between points of attachment on different IP subnets, link-layer mechanisms for mobility (i.e., link-layer handoff) may offer faster convergence and far less overhead than Mobile IP.

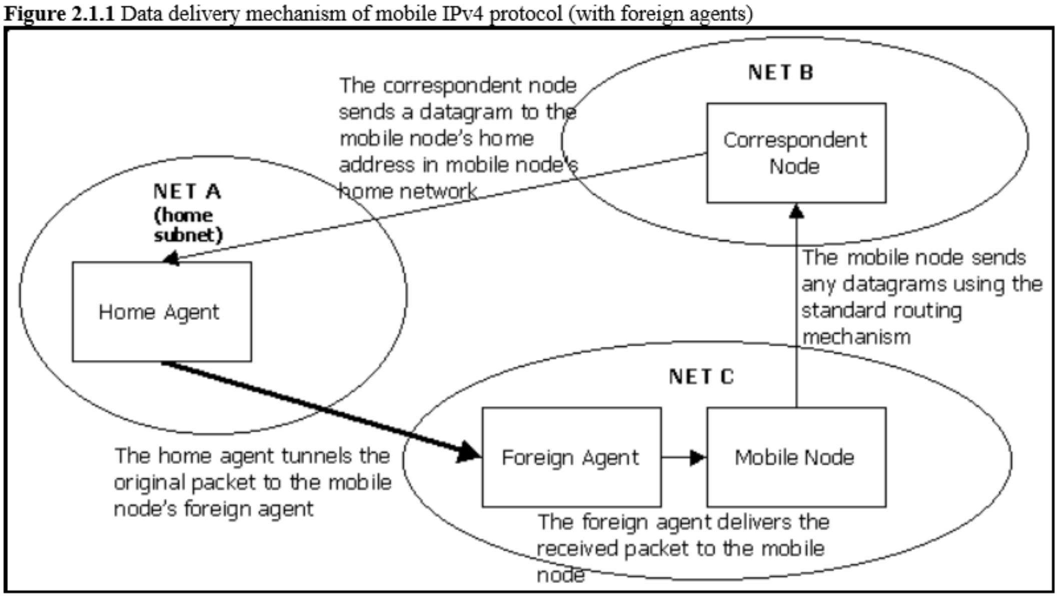
IETF RFC 2002 at § 1.4 (Oct. 1996) (emphasis added).

(b) Overview of Mobile IP

137. Many, if not all, of the exemplary embodiments of the ’417 Patent focus on the Mobile Internet Protocol (Mobile IP). Mobile IP refers generally to various Internet Engineering Task Force (IETF) communications protocols that were developed to allow mobile device users to move from one network to another while maintaining a permanent IP address.

138. During the prosecution of the patent application for the ’508 Patent,[2] the applicants disclosed to the patent office Mobile IPv4 (defined in IETF RFC 2002, published in 1996, available at https://tools.ietf.org/pdf/rfc2002.pdf). The figure below summarizes the datagram delivery mechanism used in the Mobile IPv4 protocol:

Figure 2.1.1 Data delivery mechanism of mobile IPv4 protocol (with foreign agents)



[2] The ’417 Patent is a continuation of the ’508 Patent. Thus, it is my understanding that the prosecution history of the ’508 Patent is equally relevant to the ’417 Patent.

See Kivisaari, "A Comparison Between Mobile IPv4 and Mobile IPv6", May 5, 2000, http://www.cse.tkk.fi/fi/opinnot/T-110.5190/2000/comparison_IPv4_IPv6/internetworking_seminar.html ("Kivisaari").

139. As depicted in the figure, Mobile IPv4 operates by setting up the equivalent of a forwarding system (for example, similar to the mail forwarding service offered by the U.S. Postal Service and used when someone moves residences, changing addresses, and desires their mail to be delivered to their new address). In more detail, a router on a mobile node's home network (Net A in the figure) serves as the mobile device's home agent, and one on its current network (Net C) acts as the foreign agent. The home agent receives datagrams destined for the mobile's normal IP address and forwards them to the mobile node's current location by sending them to the foreign agent using a "care-of address."[3] The home agent and foreign agent are also responsible for various communication and setup activities that are required for Mobile IP to work.

140. As the '417 Patent acknowledges, the Mobile IPv4 architecture had its disadvantages, and assorted proposals had been made to enhance its capabilities. Specifically,

[3] As discussed in column 1, lines 37-57 of the '417 Patent, in Mobile IP the mobile node uses two IP addresses:

Home Address: The "normal," permanent IP address assigned to the mobile node. This is the address used by the device on its home network, and the one to which datagrams intended for the mobile node are always sent.

Care-Of Address: A secondary, temporary address used by a mobile node while it is "traveling" away from its home network, *i.e.*, in a foreign network. It is used only by Mobile IP for forwarding IP datagrams and for administrative functions.

There are two different types of care-of addresses, which correspond to two distinctly different methods of forwarding datagrams from the home agent router:

Foreign Agent Care-Of Address: This is a care-of address provided by a foreign agent in its Agent Advertisement message. It is, in fact, the IP address of the foreign agent itself. When this type of care-of address is used, all datagrams captured by the home agent are not relayed directly to the mobile node, but indirectly to the foreign agent, which is responsible for final delivery. Since in this arrangement the mobile node has no distinct IP address valid on the foreign network, this is typically done using a layer two technology.

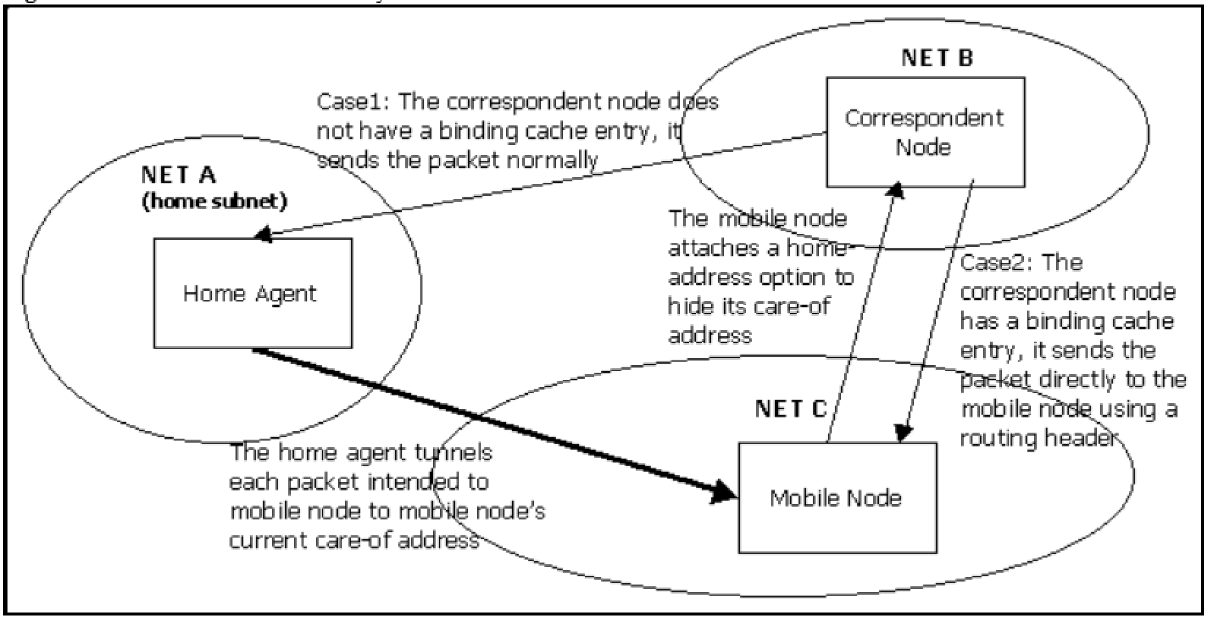
Co-Located Care-Of Address: This is a care-of address assigned directly to the mobile node using some means external to Mobile IP. For example, it may be assigned on the foreign network manually, or automatically using DHCP. In this situation, the care-of address is used to forward traffic from the home agent directly to the mobile node.

Mobile IP was designed to handle mobility of devices, but only relatively infrequent mobility. The impact of Mobile IP is discussed in RFC 2002 as solving the "macro mobility" problem in which nodes move from one IP subnet to another (requiring the nodes to be assigned a new IP address at each new location). RFC 2002 goes on the state that that Mobile IPv4 is less suited for addressing "micro mobility" ("for example, handoff amongst wireless transceivers, each of which covers only a very small geographic area."). RFC 2002 at § 1.4. The Patent-in-Suit acknowledges the same limitation with Mobile IPv4. *See* '417 Patent at 1:57-2:38. This is due to the work involved with connecting to a new network, and the overhead in setting up the new mobile IPv4 connections. *Id.* at 2:20-38. This may be acceptable when moving a computer once a week, a day or even an hour, but it can be an issue for "real-time" mobility such as roaming from one wireless network to another while in a fast moving vehicle.

141. In addition, examination of the Mobile IPv4 protocol in RFC 2002 reveals a serious drawback concerning the performance of the protocol, namely, that all packets sent by the correspondent node are always routed first to the mobile node's home network where they are intercepted by the mobile node's home agent and subsequently tunneled to the foreign agent on the foreign network in which the mobile node currently resides. This mechanism is sometimes called "triangle routing." Triangle routing generally introduces increased delay for the packets sent by the correspondent node and also places a heavy load on the home agent, which has to forward all packets sent by a correspondent node to the corresponding mobile node via the foreign agent. Kivisaari at § 3.1.

142. In 2004, the IETF developed Mobile IPv6, as specified in RFC 3775, in part to address some of the disadvantages of Mobile IPv4. The figure below summarizes the datagram delivery mechanism used in the Mobile IPv6 protocol:

Figure 5.1.2 Mobile IPv6 data delivery



Id. at § 5.1.

143. As depicted in the figure above, Mobile IPv6 allows a correspondent node to send a datagram directly to a mobile node via the mobile node's care-of-address when the correspondent node has a binding cache entry for the mobile node.[4] If the correspondent node does not have a binding cache entry, the home agent tunnels the packets to the mobile node without having to use a foreign agent between the home agent and mobile node.

144. As a network layer protocol, Mobile IP is directed to the routing of IP messages in the network layer, rather than routing in lower protocol layers such as the physical or link layers. Mobile IP is a protocol that can be used with different link layer systems, such as Wi-Fi (802.11) systems and cellular (2G, 3G and 4G) radio links. As of the July 2003 alleged priority date of the '417 Patent, there was no support in the IEEE 802.11 standard for link-layer handover between Wi-Fi access points, other than a mobile station simply disconnecting from one access point and

[4] A binding cache entry is an entry in the cache memory defined as comprising the home address, the care-of address, and a lifetime of the care-of address. Such a binding holds an association between the permanent local home address and a temporary foreign address and is valid only for a given period of time. *See* RFC 3775 at §9.1.

connecting to another. Initial steps toward such a standard were first published in the IEEE 802.11r-2008 standard on July 15, 2008, allowing for the sharing of authentication information between Wi-Fi access points to facilitate the transition between the attachment points. In parallel with 802.11r, two other amendments were published addressing other aspects of link layer transitions between access points, IEEE 802.11k-2008 (allowing "assisted roaming" through neighbor lists from the AP), and IEEE 802.11v-2008 (Access Points can send messages to a wireless client with better APs with which to connect).[5]

145. As one can recognize, in 2003, IEEE 802.11 Wi-Fi was far from being optimized for roaming from one access point to another. The setup time not only includes the time it takes to perform a Mobile IP registration process at the network layer, but also the time to change the physical and data link layer connections as well.

146. In conventional Mobile IP systems, as described in the preferred embodiments of the '417 Patent, each foreign agent broadcasted its presence to mobile nodes. They did this, for example, using network layer messages, often referred to as agent advertisement messages. These network layer messages cannot be received until the mobile node is within the coverage area of the IP network associated with a foreign agent.

(c) Fast Handovers for Mobile IP

147. Also in the prior art were adaptations of Mobile IPv4 and Mobile IPv6 using so-called "Fast Handovers," wherein wireless access networks addressed micro-mobility based upon detecting signal levels from neighboring base stations or by predicting the mobile node's likely

---

[5] *See* Cisco.com, Enterprise Mobility Design Guide, https://www.cisco.com/c/en/us/td/docs/wireless/controller/8-1/Enterprise-Mobility-8-1-Design-Guide/Enterprise_Mobility_8-1_Deployment_Guide/Chapter-11.html.

movements, and configuring resources proactively prior to the handing over the mobile node to a new access router (or foreign agent in the IPv4 context). The details of each are provided below.

> **Fast Handovers for Mobile IPv6**
>
> The main idea of this protocol is that it is often known what the next Access Router is likely to be before the mobile actually hands over on to it. ***This 'hint' could, for example, come from power or signal-to-noise ratio measurements, or from knowledge of a mobile's likely movements (e.g. if it is on a train). Hence, some proactive action can be taken in advance of the actual handover - if desired, the handover can be initiated before the MN has connectivity with the new AR***. Overall, this should mean that from the point of view of ongoing communications between the mobile and its correspondents, the handover is apparently smoother and faster. This type of approach is familiar from current cellular networks, where the mobile reports on the signal strength from nearby base stations, thus allowing the network to plan for handovers.
>
> The basic ideas are to:
>
> - Enable the mobile node to configure a new CoA before it moves on to the new AR, so that it can use the new CoA as soon as it connects with the new AR. This eliminates the delay seen in mobile IP from the registration process, which can only begin after the Layer 2 handover to the new AR is complete. There is an implicit assumption that the mobile is only capable of connecting with one AR at a time, i.e. break before make, otherwise the mobile IP feature above (two CoAs) can be used.
>
> - Ensure that no packets are lost during the handover by establishing a temporary tunnel from the old to the new AR. The technique is basically an extension of the MIP feature above (point 3) to the case of a planned handover.

IP for 3G at 135-36 (emphasis added).

> **Fast Handovers for Mobile IPv4**
>
> Fast handovers (or 'low latency handoffs' in their terminology) have also been considered for mobile IPv4. At present, there are several differences from fast mobile IPv6, and in fact, fast mobile IPv4 currently includes two different techniques called pre- and post-registration. Fast mobile IPv4 and v6 might be expected to converge on the same basic approach.

> ***The 'pre-registration' method has the same idea as fast mobile IPv6 above, in that a proxy router advertisement from the old foreign agent is used to inform the mobile node about the prospective new foreign agent***. There are several slight differences, which mainly stem from using a normal registration request/reply (i.e. there are not special 'fast' messages).

Id. at 136-37 (emphasis added).

148. Fast Handovers for Mobile IPv4 and Mobile IPv6 demonstrate that the general concept of using proxies and location prediction to speed up the handover process were already known.

(d) UMTS and Mobile IP

149. Even as early as 2002, UMTS Release 5 taught the use of Mobile IP (RFC 2002) for use in macro-mobility (between different access networks), but choose to utilize link layer handoffs (layer 2) for micro-mobility (within the UTRAN and GERAN radio access networks). *See, e.g.*, 3GPP 23.060 v.5.1.0 (3/2002) at 31, see also 3GPP 23.121 V3.6.0 (6/2002) at § 4.10.

> ## 5.7 Functionality Needed for Mobile IP Using IPv4
>
> To support the optional Mobile IP services, see 3GPP TS 23.121 [54], efficiently by GPRS, Foreign Agent (FA) functionality needs to be provided in the GGSN. The interface between the GGSN and FA, including the mapping between the care of IP address and the GTP tunnel in the PLMN is not standardized as the GGSN and FA are considered to be one integrated node.
>
> Mobile IP services need a Home Agent (HA). The HA is a router that tunnels datagrams to an FA. The FA de-tunnels the datagrams and sends them towards the MS that is in a PLMN. The HA maintains current location information for each of the departed users. The location of the HA is outside the scope of the 3GPP specifications.
>
> The FA and HA functionality is specified in RFC 2002 [46].

3GPP TS 23.060 v.5.1.0 (3/2002) at § 5.7; *see also* 3GPP TS 23.121 v3.6.0 (6/2002) at § 4.10 (Mobile IP for UMTS/GPRS End Users).

150. The UMTS standard provides additional detail relating to the use of Mobile IP (RFC 2002) integrated with the GGSN functionality in 3GPP TS 23.121 v.3.6.0, as referenced in 3GPP TS 23.060 v.5.1.0. These references are prior art to the '417 Patent.

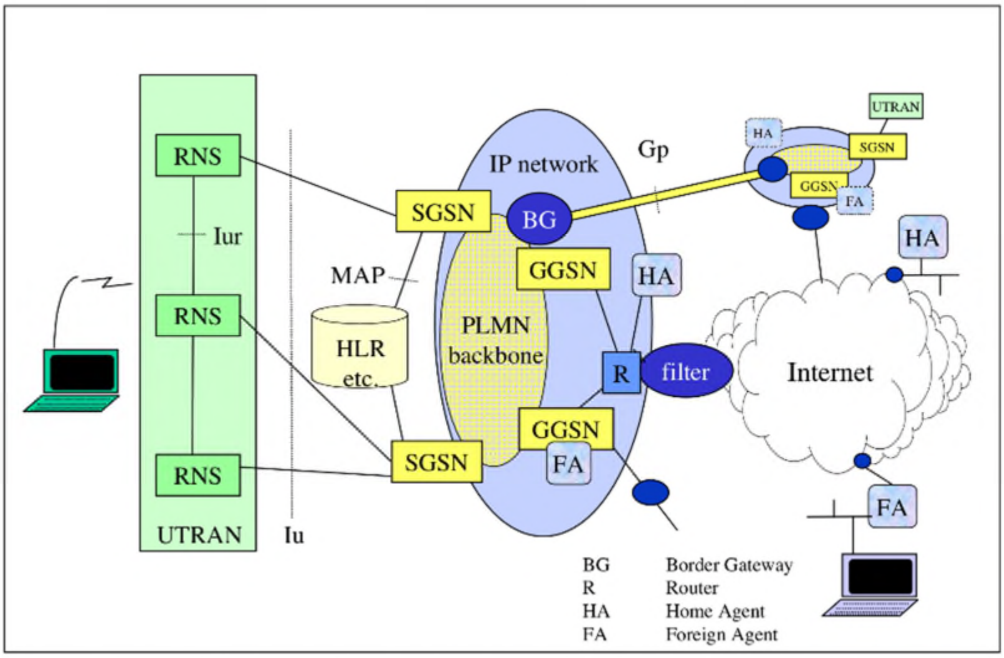


Figure 4.46: Core network architecture with GPRS MM within the PLMN's and Mobile IP MM between different types of systems

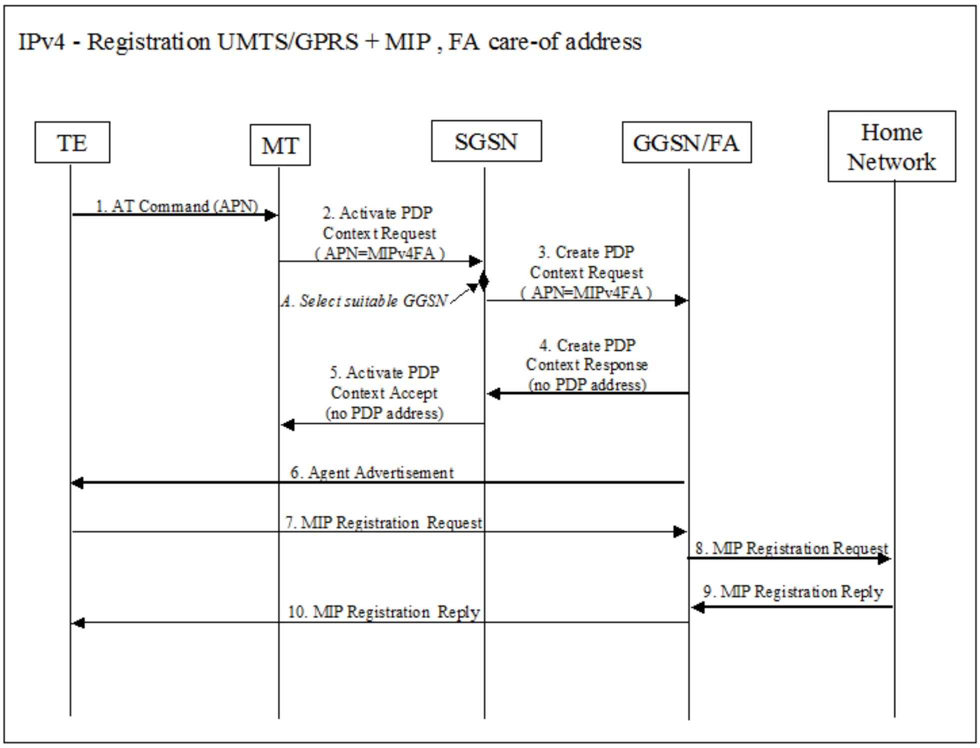


Figure 4.47: PDP Context activation with Mobile IP registration (the PPP setup and UMTS/GPRS attach procedures not included)

3GPP TS 23.121 v.3.6.0 at § 4.10.1 (Figs. 4.46 & 4.47).

6. <u>"All-IP" Access Networks and the Evolution from 3G to 4G</u>

151. In Release 5 of the 3GPP UMTS standard, each link between the core network nodes were transportable by IP. However, there was discussion at the time relating to a generalized IP network being used to interconnect the RAN and the core networks. The following are examples of some of those state of the art concepts that led to the development of the 4G LTE standard.

152. The following figure shows a first attempt at an all-IP architecture, where instead of Node Bs there are Access Routers, and instead of GGSNs there are Gateways. IP for 3G at 207. Access routers are connected to an IP access network, which is connected to the general Internet. RNCs or other intermediary network nodes are not apparent.

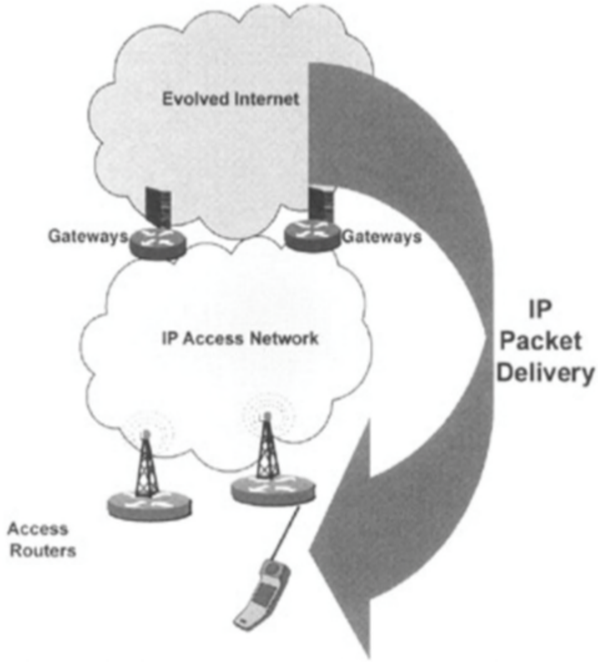
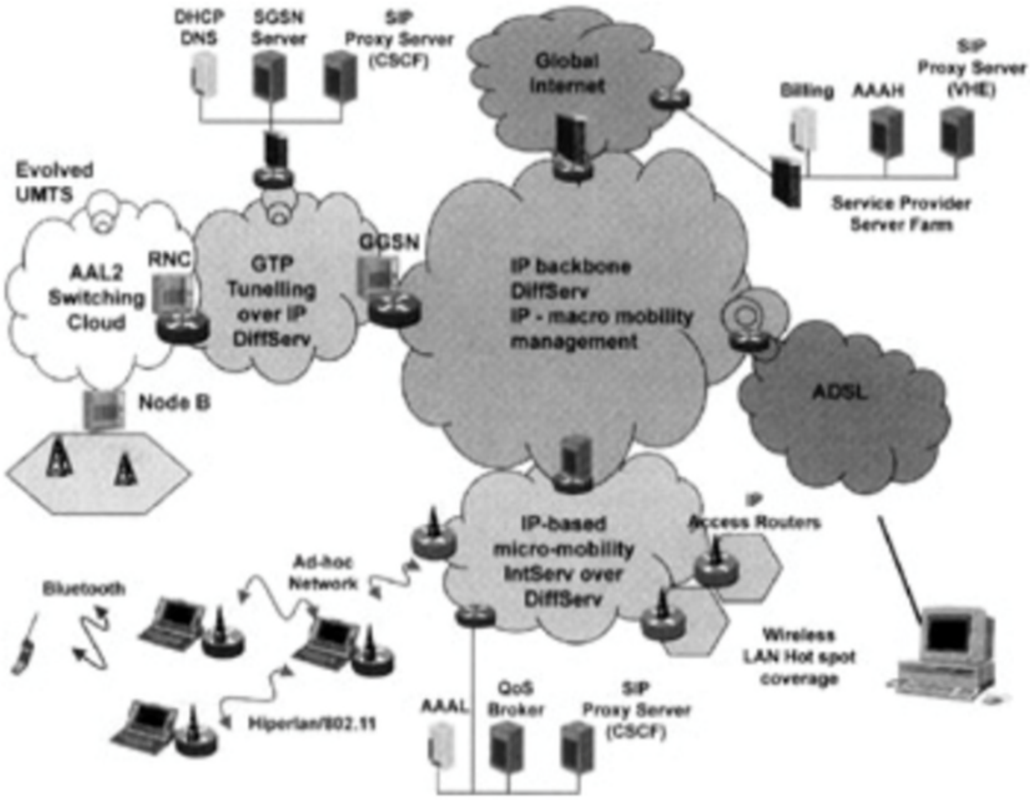


Figure 7.1: Outline all-IP mobile network architecture.

153. The following figure depicts another example of an all-IP wireless network having a number of different access networks, including ADSL, IP-based micro-mobility IntServ over DiffServ a SIP Proxy Service (generally part of an IMS VoIP system), Hyperlan/802.11, and an

"Evolved UMTS" which appears to be the next generation of systems after UMTS. These radio access networks are interconnected using a macro-mobility system based on IP.



Id. at 211-12.

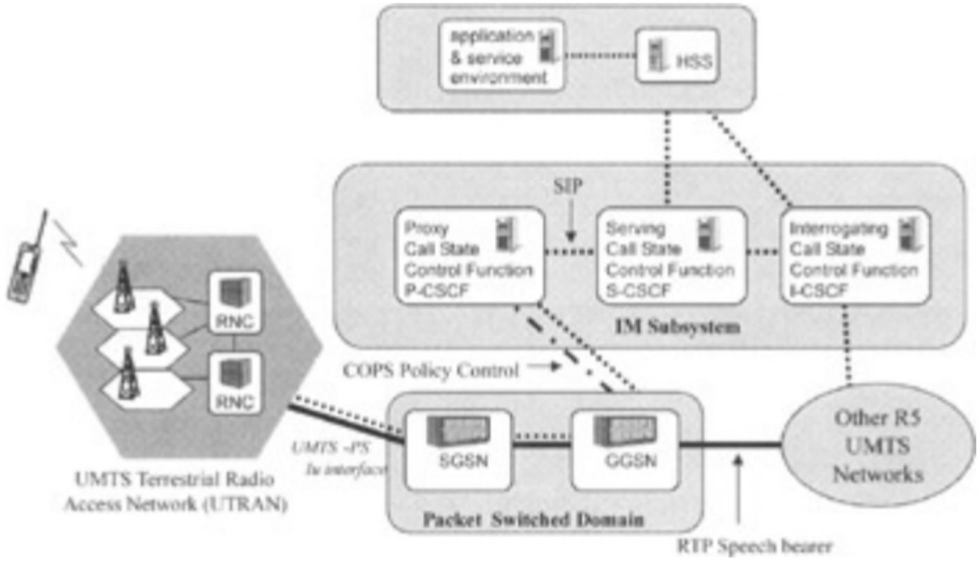
154. In 2002, the two main concepts that were in development for improving 3G UMTS was Voice over IP (VoIP) and IP call/session signaling for multimedia services *Id.* at 214. UMTS Release 4 was only concerned with the Core network part of the circuit-switched domain (CS-Domain)—the UTRAN and packet switched (PS) domain remain the same. Release 4 took the I_u-CS interface and allows it to be connected to a media gateway so that the voice traffic can be carried in IP packets—a form of voice over IP (VoIP)." *Id.* Furthermore:

> Operators might also have a core IP backbone that can then be used for all fixed and mobile traffic. In R4, it is also possible to dimension the user plane and control plane functions separately - Media

> Gateways (MG) or Media Gateway Controllers (MGC) can be added independently …. Finally, R4 represents an evolutionary step towards a full VoIP solution - where voice is packetised in the terminal. It was considered too large a step for operators, manufacturers, and standards bodies to achieve this in a single development.

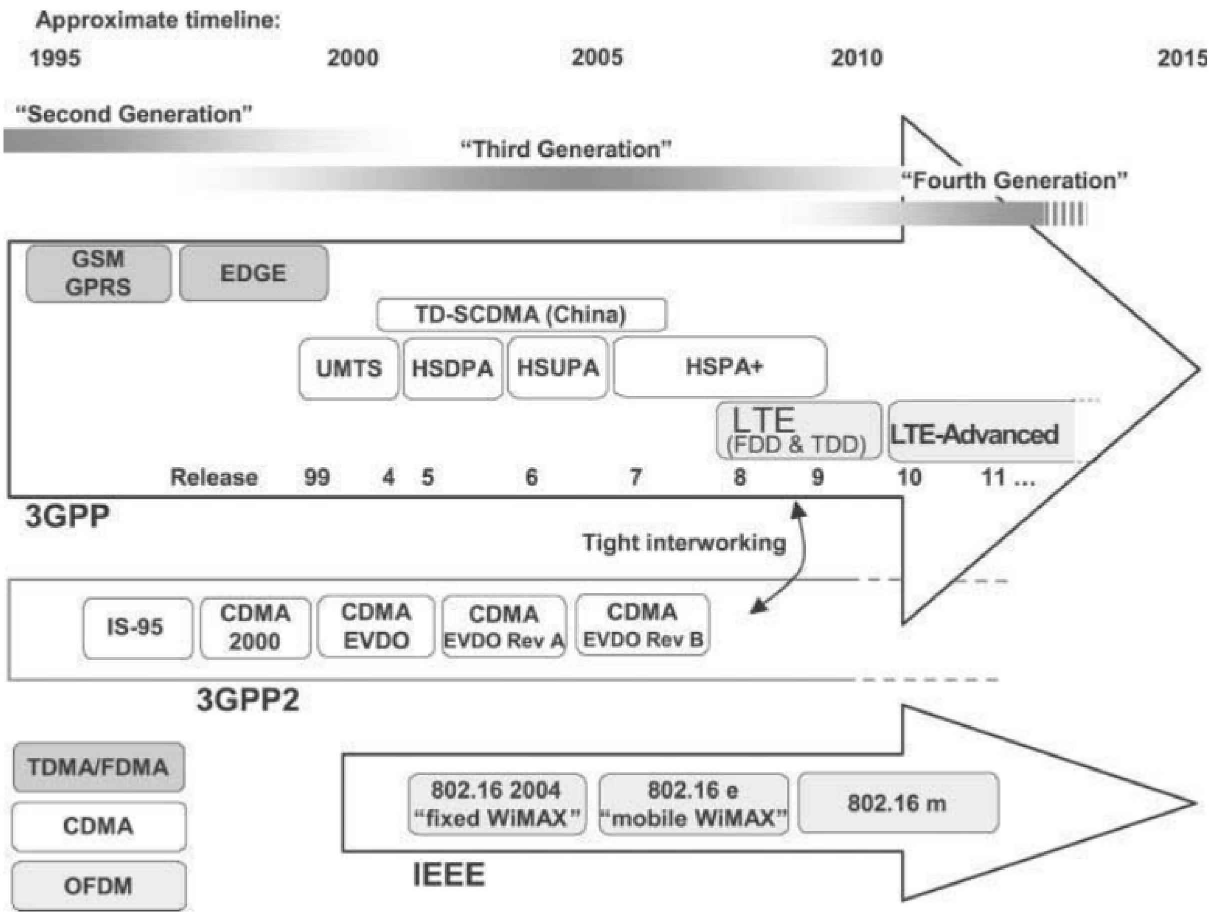
Id. at 215.

155. UMTS Release 5 changed the packet switched (PS) core network (among other enhancements). However, the circuit-switched part of the core could be the MSC/GMSC of Release 3 or the MSC-server/MG architecture of Release 4. Release 5 introduced two major elements to the PS core network: (i) a new core network domain called "Internet Multimedia core network subsystem" (IMS); and (ii) an upgrade to the GSNs to support real-time voice and other delay-sensitive services. *Id.* The UTRAN was also upgraded to support real-time handover of PS traffic but was otherwise unchanged, with the interface between the core network and UTRAN being via the normal AAL5 Iu(PS) interface." *Id.* The overall Release 5 architecture is shown in the figure below:



Id. at 215 (Fig. 7.5).

156. The following figure provides a timeline for the deployment of the various generations and release of wireless radio access networks, and core networks. As shown, the 4G LTE standard was the next step in the 3GPP evolution from UMTS.



Sesia at 45 (Fig. 1.1).

157. As discussed above, "evolved" UMTS systems were being considered prior to the filing date of the '417 Patent, an example of which is shown in the figure below.

IP for 3G at 212 (Fig. 7.3).

158. The above figure additionally includes the Call State Control Function (CSCF), which is portion of the IMS network for supporting VoIP, which was first standardized in UMTS Release 5.

159. The following table provides a mapping of UMTS (3GPP Release 99 +) to LTE (3GPP Release 8+) elements having similar functionality.

UMTS	**LTE/EPC**
User Equipment (UE)	**User Equipment (UE)**
Radio network substem (RNS) - Radio Network Controller (RNC) - NodeB	**evolved NodeB (eNodeB)** The combination of RNC functionality with one or more cells
Universal subscriber identity (USIM)	**Universal subscriber identity (USIM)**
Serving GPRS Support Node (SGSN) Control Plane (Signaling, Authentication) & User Plane	**Mobility Management Entity (MME)** Control Plane (Signaling, Authentication)
	Serving Gateway (SGW) User Plane
Gateway GPRS Support Node (GGSN)	**Packet Gateway (PGW)**

Mobile Switching Center (MSC)	**IP Multimedia Subsystem (IMS)** including the P-CSCF as an interface to the 3G (GGSN) and LTE (PGW).

The following figures also demonstrate the correlation of network elements:

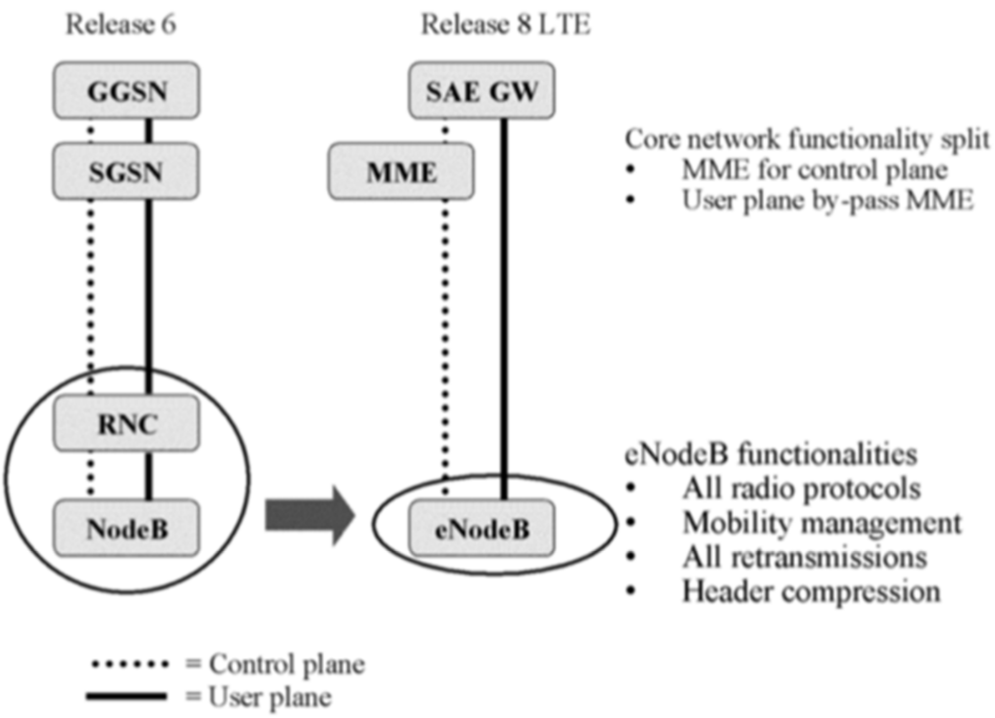


Figure 1.8 LTE network architecture

Holma et al., "LTE for UMTS: OFDMA and SC-FDMA Based Radio Access" (2009) ("Holma") at 6 (Fig. 1.8).

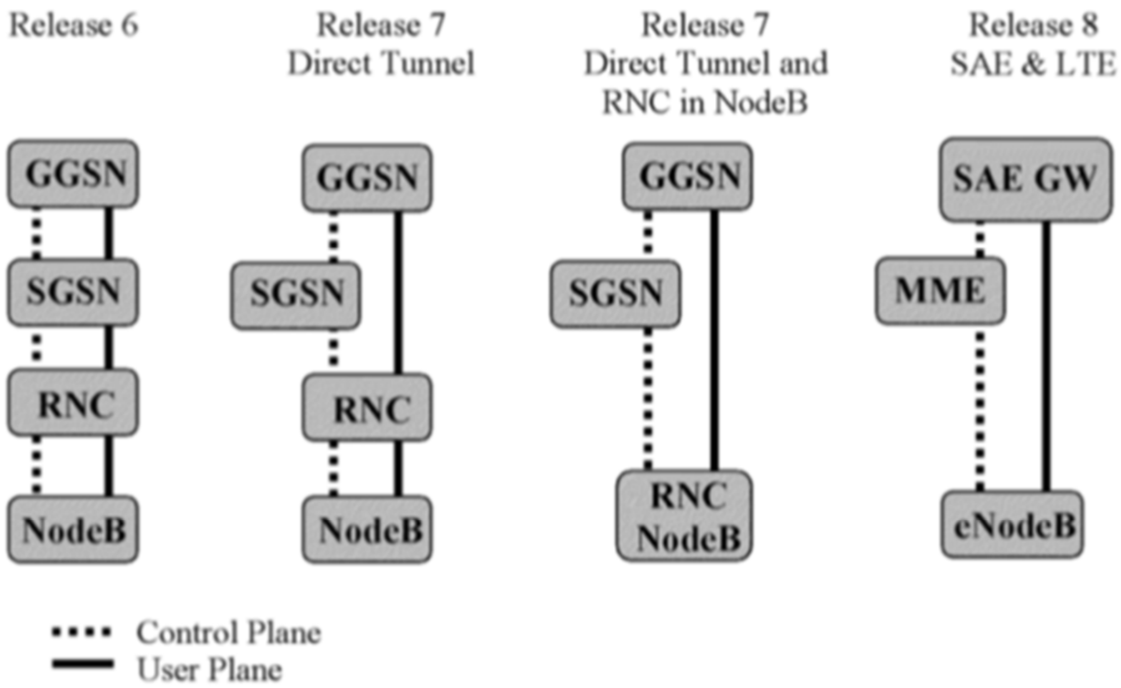


Figure 3.1 3GPP architecture evolution towards flat architecture

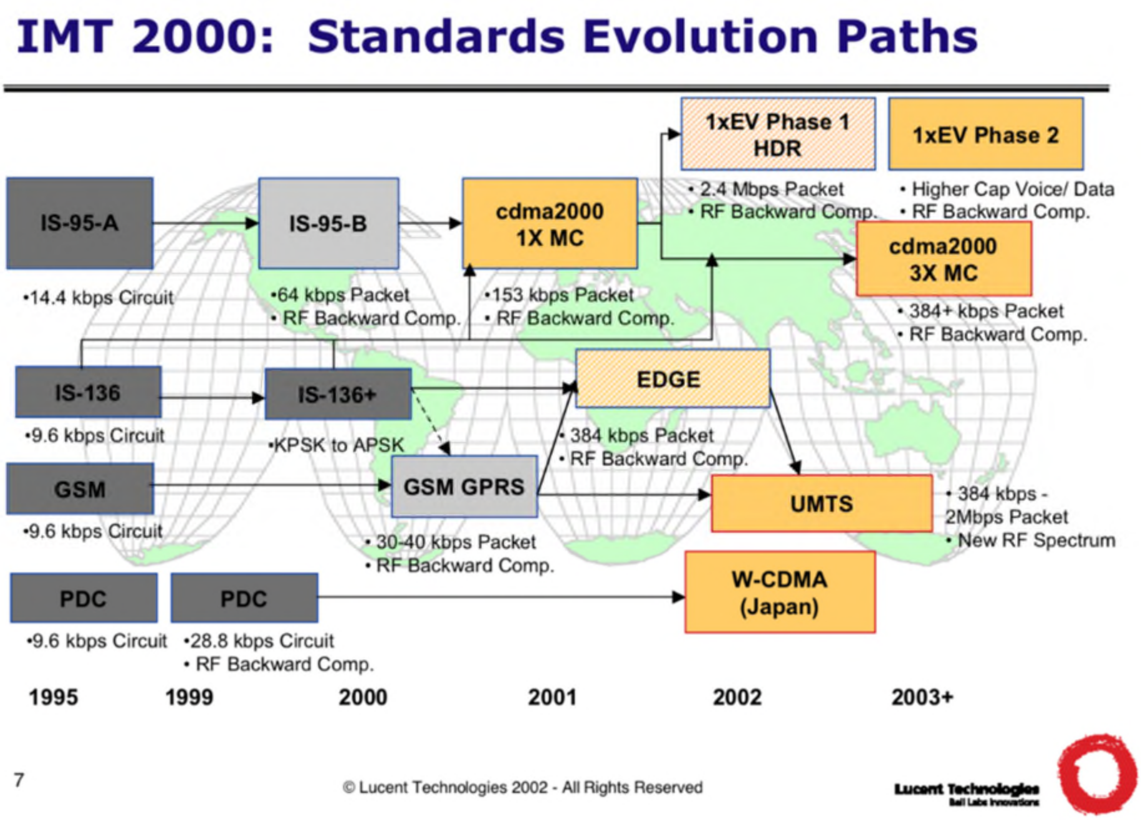
Id. at 24 (Fig. 3.1).

B. The ’330 Patent

1. Background of Compliance Testing

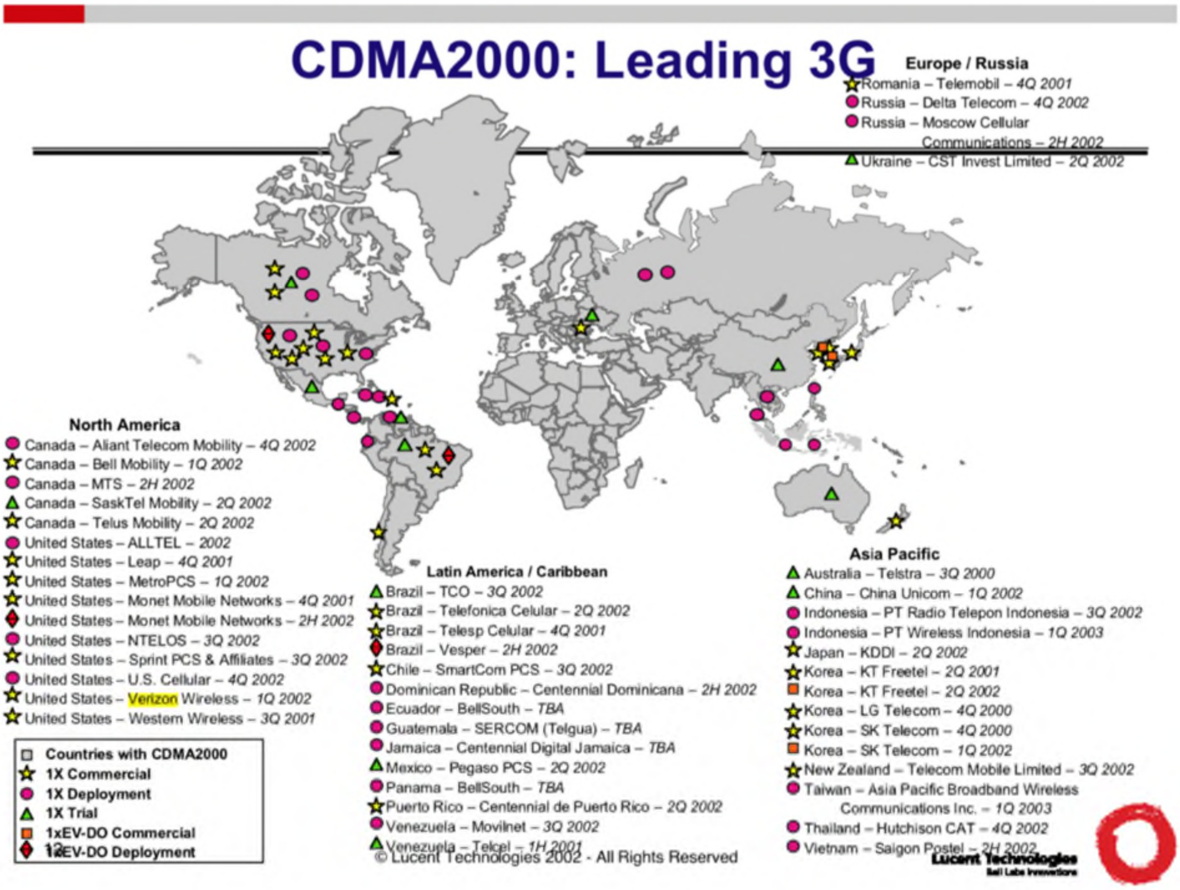
160. As discussed above, wireless systems, both cellular and home networking (WiFi/802.11) had been available on the market for some time by the priority date of the ’330 Patent of July 31, 2003. As one of ordinary skill in the art would understand, all wireless systems required testing prior to their deployment. This included both Wi-Fi (802.11) and cellular systems. The following figure depicts the wireless cellular systems that had been standardized and deployed as documented by the International Telecommunications Union (ITU) in 2002.[6]

[6] CDMA2000 Benefits and Market Status, *available at* https://www.itu.int/ITU-D/tech/events/2002_2000/Abidjan2002/documents/2-3_Gorham.pdf at 7 (last visited May 16, 2019).



161. In fact, Verizon had deployed some of the above cellular systems for some time prior to the priority date of the '330 Patent. For example, Verizon had deployed IS-95 and CDMA2000-based systems at the time of the priority date of the '330 Patent, as shown in the below figure.[7]

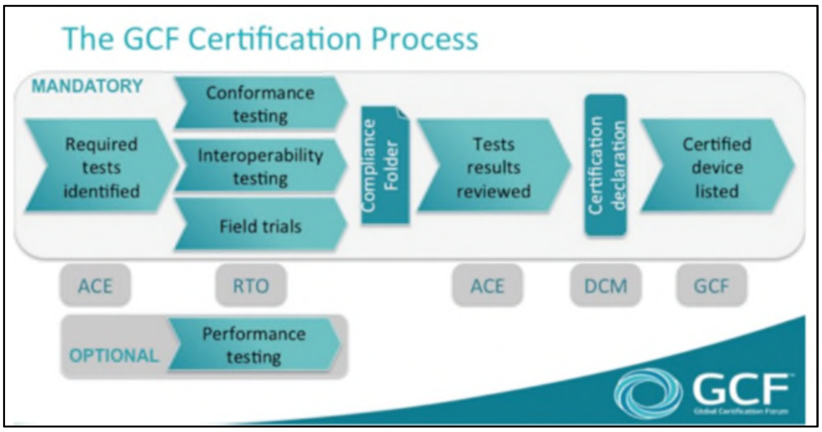
[7] CDMA2000 Benefits and Market Status, *available at* https://www.itu.int/ITU-D/tech/events/2002_2000/Abidjan2002/documents/2-3_Gorham.pdf at 13 (last visited May 16, 2019).



162. Part of the process of vendors' development of mobile devices is the verification that the devices are going to interoperate with other network nodes (such as base stations) and the core network owned by the various operators supporting the standard. This process is generally referred to as "compliance testing." Each of the standards listed above include provisions for compliance tests to verify manufacturers' devices. Additionally, organizations were set up to certify third-party test labs and perform reviews of the results to provide official certification of compliance to particular interoperability and minimum performance requirements. Generally, these same laboratories were also able to certify compliance to regulatory requirements imposed by the Federal Communications Commissions (FCC), or Underwriters Laboratories (UL).

2. Compliance Testing Oversight

163. One organization which provided (and continues to provide) compliance testing oversight was Global Certification Forum ("GCF"), which was founded in 1999. This organization is responsible for the compliance certification of mobile devices ranging from GSM, WCDMA, and now LTE. The GCF's activities range from: conformance tests (to the 3GPP specifications, and in the lab); interoperability tests and field trials (to ensure a mobile devices works with different base station manufacturers' equipment); over-the-air tests; and performance testing (GCF PC & GCF AC). The GCF certification process is generally applicable to Europe.[8]

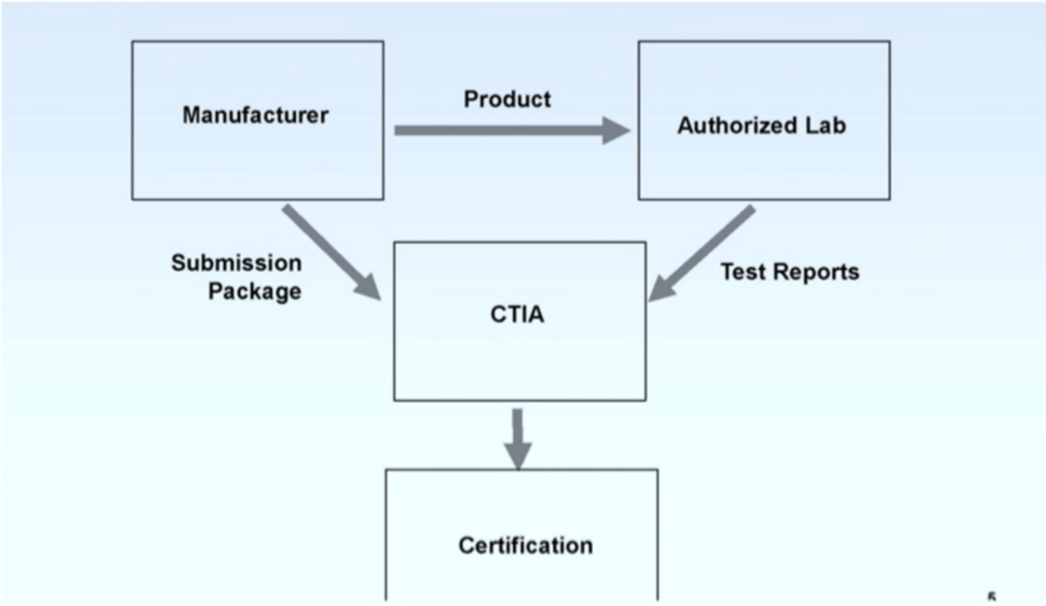


164. In the United States, there is a similar organization called the PTCRB, which was founded by the U.S.-based wireless operators in 1997, and is managed by the Cellular Telephone Infrastructure Association (CTIA). This certification process is illustrated in the below figure.[9]

---

[8] GCF Certification, "Test once, use anywhere" certification for mobile devices, *available at* https://www.globalcertificationforum.org/news/whitepapers.html at 6 (last visited May 16, 2019).

[9] Introduction of Typical global certification system, *available at* https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Session%208-1%20Introduction%20of%20Typical%20global%20certification%20system%20(GCF,PTCRB,CTIA)演示版150906.pdf at 26 (last visited May 16, 2019).



3. Operator Acceptance Testing

165. Following compliance and regulatory certification, the wireless network operators (like Verizon) typically performed (including prior to the priority date of the '330 Patent) "operator acceptance testing" to ensure the devices work correctly within their own networks. The flow of this testing process is illustrated in the below figure.[10]

166. As part of the above certifications, various tests must be performed on the mobile device. These tests include verifying the performance of handovers between network nodes, as well as confirming performance the mobile device applications on the operators' networks.

[10] Introduction of Typical global certification system, *available at* https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Session%208-1%20Introduction%20of%20Typical%20global%20certification%20system%20(GCF,PTCRB,CTIA)演示版150906.pdf at 24 (last visited May 16, 2019).

4. Minimum Performance Standards Set by Industry Organizations

167. As part of such operator acceptance testing, carriers ensured that certain “minimum performance requirements” for handover were met. As one example, for the CDMA2000 prior art 3G systems, several test configurations were typically required. The CDMA Development Group (“CDG”) was the industry organization in the US which developed CDMA2000, as well as IS-95-based CDMA interoperability documents and tests.

168. One of the CDG documents describes testing of IS-95B handoffs for performance and delay in a number of emulated conditions. Such conditions and scenarios are listed as follows:

3 HANDOFF TESTS

Table 3-1 lists handoff tests in this section and their applicability to various mobile station types as defined in the Foreword.

Table 3-1 Handoff Test Applicability to Mobile Station Types

Test No.	Title	Applicability to mobile station types			
		CDMA 800 & AMPS	CDMA 1900 Only	CDMA 1900 & AMPS	CDMA 800,1900 & AMPS
3.1	Reserved	N/A	N/A	N/A	N/A
3.2	Reserved	N/A	N/A	N/A	N/A
3.3	Soft Handoff with Dynamic Threshold	YES	YES	YES	YES
3.4	Hard Handoff Between Frequencies in the same band without return on failure	YES	YES	YES	YES
3.5	Reserved	N/A	N/A	N/A	N/A
3.6	Hard Handoff from CDMA to AMPS	YES	NO	YES	YES
3.7	Hard Handoff to Soft Handoff on Same Frequency	YES	YES	YES	YES
3.8	Soft Handoff in Fading, 1 Path at 30 km/hr	YES	YES	YES	YES
3.9	Soft Handoff in Fading, 3 Ray Rayleigh, at 100 km/hr	YES	YES	YES	YES
3.10	Soft Handoff in Fading, 1 Ray Rayleigh, at 3 km/hr	YES	YES	YES	YES
3.11	Hard Handoff Between Frequencies in the same band, 1 Ray Rayleigh, at 30 km/hr	YES	YES	YES	YES
3.12	Hard Handoff Between Frequencies in the same band, 3 Ray Rayleigh, at 100 km/hr	YES	YES	YES	YES
3.13	Hard Handoff Between Frequencies in the same band, 1 Ray Rayleigh, at 3 km/hr	YES	YES	YES	YES
3.14	Hard Handoff On Same Frequency, 1 Ray Rayleigh, at 30 km/hr	YES	YES	YES	YES
3.15	Hard Handoff on Same Frequency, 3 Ray Rayleigh, at 100 km/hr	YES	YES	YES	YES
3.16	Hard Handoff on Same Frequency, 1 Ray Rayleigh, at 3 km/hr	YES	YES	YES	YES

June 20, 2000 Revision 2.0

Page 3-2 CDG Stage 2 Interoperability Tests (TIA/EIA-95-B)

Table 3-1 Handoff Test Applicability to Mobile Station Types (continued)

Test No.	Title	Applicability to mobile station types			
		CDMA 800 & AMPS	CDMA 1900 Only	CDMA 1900 & AMPS	CDMA 800,1900 & AMPS
3.17	Reserved	N/A	N/A	N/A	N/A
3.18	Hard Handoff Between CDMA 800 and CDMA 1900 without return on failure	NO	NO	NO	YES
3.19	Reserved	N/A	N/A	N/A	N/A
3.20	Hard Handoff Between Frequencies in the Same Band with Return on Failure	YES	YES	YES	YES
3.21	Hard Handoff from CDMA 800 to CDMA 1900 with Return on Failure	NO	NO	NO	YES
3.22	Hard Handoff from CDMA 1900 to CDMA 800 with Return on Failure	NO	NO	NO	YES
3.23	Search Window per Neighbor	YES	YES	YES	YES
3.24	Access Handoffs	YES	YES	YES	YES

CDG Stage 2 Interoperability Tests (TIA/EIA-95-B), Revision 2.0, CDG 53 (June 20, 2000) at 3-1, VZ_MW_Prior Art_013509-013798 ("CDG 53").

169. From the same document (CDG 53), Figure 3.8.2-1 depicts the functional setup for testing soft handoff in wireless fading conditions. In this figure below, one can see multiple base stations interfacing with a mobile device via respective attenuators and channel simulators to verify the handover performance.

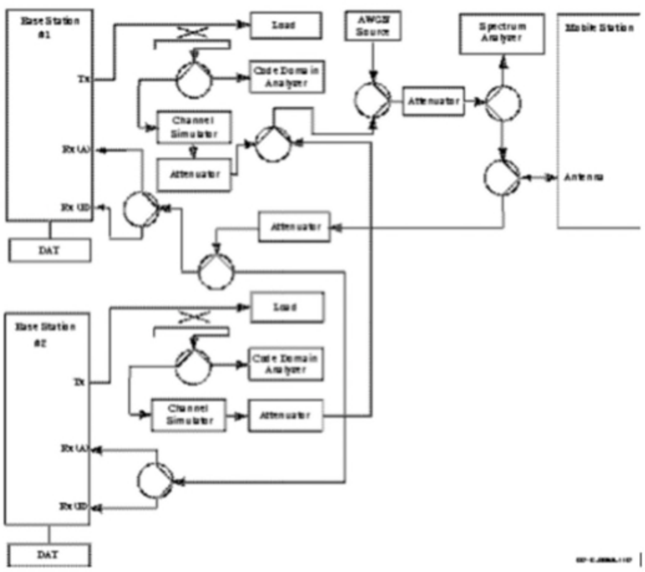


Figure 3.8.2-1 Functional Setup for Testing Soft Handoff in Fading, 1 Ray Rayleigh at 30 km/hr

CDG 53 at 3-10 (Figure 3.8.2-1).

170. In a similar figure from CDG 53, once can see the test configuration for a hard handoff verification, as required at the time by the prior art IS-95B (CDMA2000) devices deployed on Verizon's network.

PAGE 6-10 CDG Stage 2 Interoperability Tests (TIA/EIA-95-B)

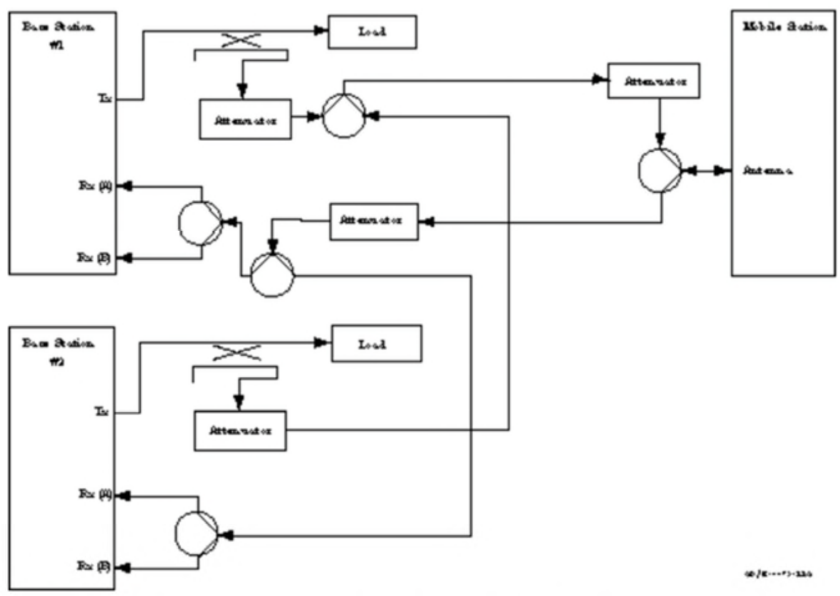


Figure 6.10.2-1 Functional Setup for Hard Handoffs between Base Stations with SME Active

6.10.3 Minimum Standard

When Signaling Message Encryption is activated, sensitive data is encrypted and sent on the traffic channel. When an active call is handed off from base station 1 to base station 2, or another sector the SME mode is passed on to the base station or sector to which the call has been handed off.

CDG 53 at 6-10 (Figure 6.10.2-1).

171. The CDMA2000 standards themselves included specific interoperability tests as well as minimum performance tests. In association with the CDMA2000 network, the following diagram depicts the overall reference model associated with various (hard, soft, softer) handoffs.[11]

[11] 3GPP2 A.S0011-0, Version 1.0, Interoperability Specification (IOS) for CDMA 2000 Access Network Interfaces – Part 1 Overview (Nov. 16, 2001), *available at* https://www.3gpp2.org/Public_html/Specs/A.S0011-0_v1.0.pdf, at Figure 3.2.1 (last visited May 16, 2019).

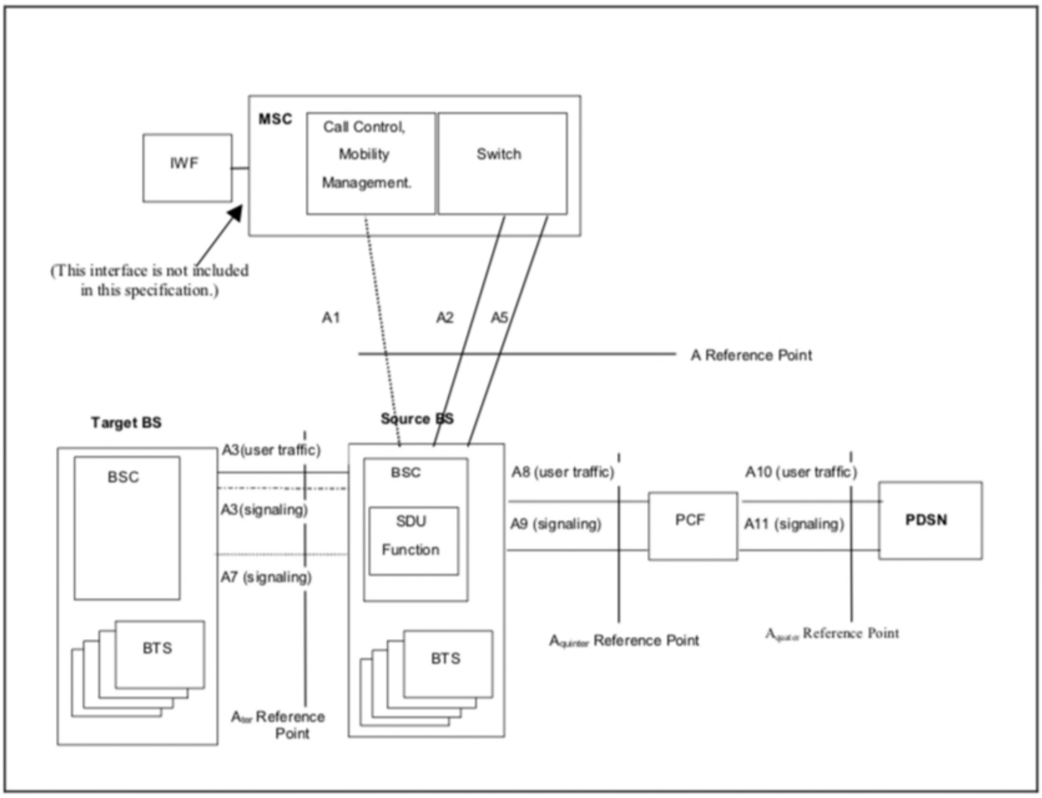


Figure 3.2-1 Reference Model for cdma2000 Access Network Interfaces

172. It should be noted that various concepts related to mobility are discussed in this same prior art document relating to micro and macro mobility within a CDMA2000 3G system, as well as using mobile IP including both home agents and foreign agents associated with macro mobility.

173. The mobile IP protocol "stack" for IS-2000 is depicted in the following figure from a different document of the same standard, in 2001.[12]

[12] 3GPP2 P.S0001-A, Version 3.0, Wireless IP Network Standard (July 16, 2001), *available at* https://www.3gpp2.org/Public_html/Specs/P.S0001-A_v3.0.pdf, at 6, Fig. 2 ("P.S0001-A").

1 Introduction

This specification defines requirements for support of wireless packet data networking capability on a third generation wireless system based on cdma2000. This specification is based on P.R0001; cdma2000 Wireless IP Network Architecture based on IETF protocols.

This specification defines the two methods for accessing Public networks (Internet) and Private networks (Intranets): Simple IP and Mobile IP, and the required Quality of Service and Accounting support. IETF protocols are widely employed whenever possible to minimize the number of new protocols required and to maximize the utilization of well accepted standards and hence the speed to market. References to the required IETF protocols are provided in Section 3 of this specification.

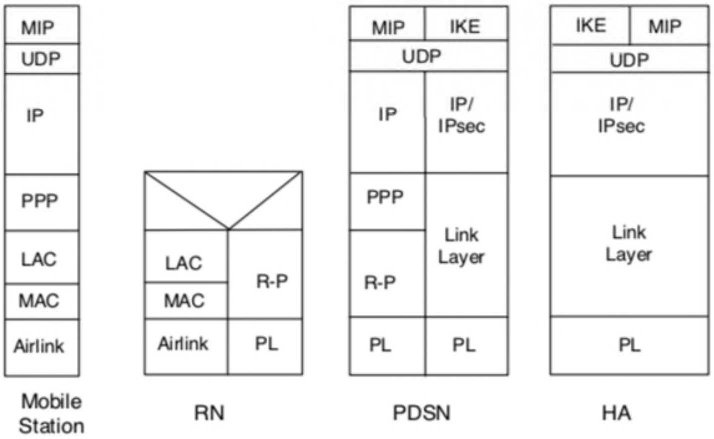


Figure 2: Protocol Reference Model for Mobile IP Control and IKE

174. The following depicts the CDMA2000 network using Mobile IP as a reference model.

P.S0001-A

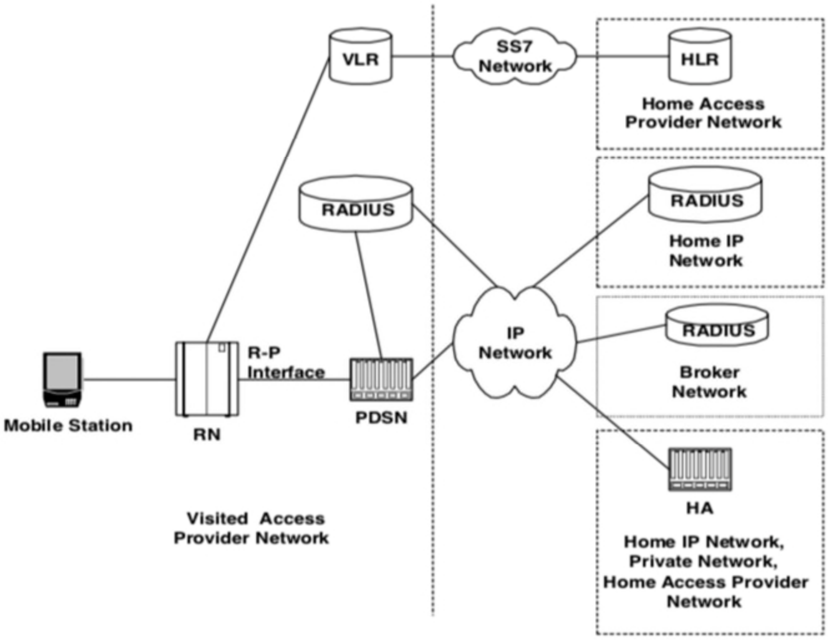


Figure 5: Reference Model for Access with Mobile IP

P.S0001-A at 16 (Fig. 5).

175. Using mobile IP within the CDMA2000 network is similarly discussed in the following:

6 Mobile IP Operation

This section describes the requirements and procedures for Mobile IP operation. In this specification, Mobile IP refers to a service based on a set of RFCs (including RFC 2002), in which the user is provided IP routing service to a public IP network and/or secure IP routing service to predefined private IP networks. The MS is able to use either a non-zero static IP address or a dynamically assigned IP address belonging to its home IP network HA. The MS shall have a non-zero static Home Agent address assigned regardless of whether the mobile station has a static or dynamic Home Address. The user is able to maintain a persistent IP address even when handing off between radio networks connected to separate PDSNs.

6.1.2 Mobile IP

Mobile IP operation shall be supported as defined in the following standards with any limitations or extensions described in this specification:

- RFC 2002-2006;
- Reverse Tunneling [RFC 2344];
- Foreign Agent Challenge/Response [RFC 3012];
- NAI Extension [RFC 2794]

P.S0001-A at 24.

7.3 *PDSN to PDSN Handoff*

Mobile IP provides the IP layer mobility management function that maintains persistent IP addresses across PDSNs. There is no similar IP layer mobility management function support between PDSNs for Simple IP service. For Mobile IP mobile stations, in order to maintain persistent IP addresses, the mobile station will effect a PDSN to PDSN handoff by registering with its Home Agent as per RFC 2002 with extensions as outlined in Section 6 above.

A PDSN to PDSN handoff requires the mobile station be active or to transition to the active state. The PDSN to PDSN handoff for Mobile IP involves:

- Establishment of new PPP session
- Detection of new Foreign Agent via the Agent Advertisement Message
- Authentication by RADIUS infrastructure
- Registration with the Home Agent

P.S0001-A at 34.

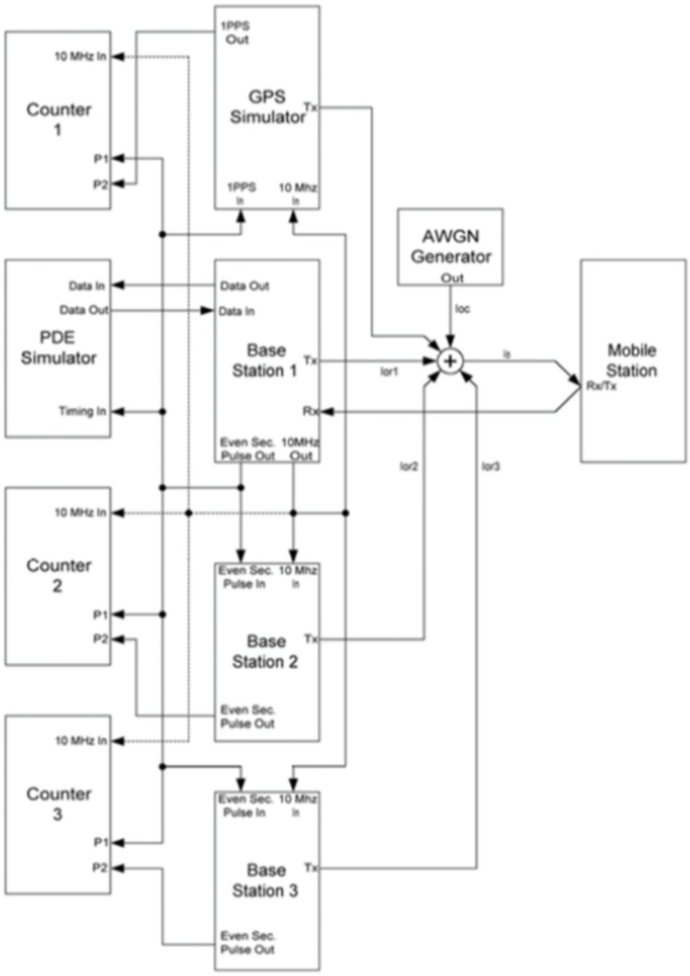
176. Hard handover times in CDMA2000 were quite fast to support real time voice communications, as well as packet data services. For example, the IS-2000 requirements mandated a maximum duration of 500 ms – 362 ms = 138 ms (see 3GPP2 C.S0033 at 6.1.1.2.4.3 Minimum standard) associated with an inter-frequency hard handoff. This is in direct contradiction to the ’417 Patent’s background asserting that the current mobile IP handover interruption times are problematic. ’417 Patent at 2:20-30. It should be noted that at the time of the filing of the patent applications leading to the ’417 and the ’330 Patents, the CDMA2000 system had been deployed by Verizon and had almost certainly been conforming to the requirements for acceptable intra-frequency and inter-frequency hand-offs for both voice and packet data systems. Further, such systems were undoubtedly being verified according to the simulation/emulation systems required by the standards and industry organizations as discussed herein.

177. Other emulated test setups were further specified for use in the various minimum performance testing requirements. One example is a test setup for positioning. As one can see from

the below figure, the following block diagram includes a GPS simulator with multiple base stations, a network node emulator (PDE Simulator), and a mobile station.[13]

3GPP2 C.S0036-0 v1.0

Figure 5.9.1-3 Functional Set-up for Hybrid Tests



5-16

13 C.S0036-0 v1.0 - 3GPP2, *Recommended Minimum Performance Specification for C.S0022-0 Spread Spectrum Mobile Stations*, March 11, 2002, at 5-18, *available at* https://www.3gpp2.org/Public_html/Specs/C.S0036-0_v1.0.pdf (last visited May 16, 2019).

5.8 PDE Simulator Equipment

The PDE simulator equipment provides a uniform network assistance environment for every mobile station under test. Optionally, parts or all of the measurement data evaluation may also be carried out by the PDE simulator equipment.

The PDE simulator shall be capable to transmit and receive *Data Burst Messages* to and from the serving base station.

5. <u>Commercial Test Equipment</u>

178. Vendors developed commercial equipment in association with the conformance specifications for use by equipment manufacturers and wireless operators for performance and conformance verification. Examples of such systems are depicted in the following figures.[14]

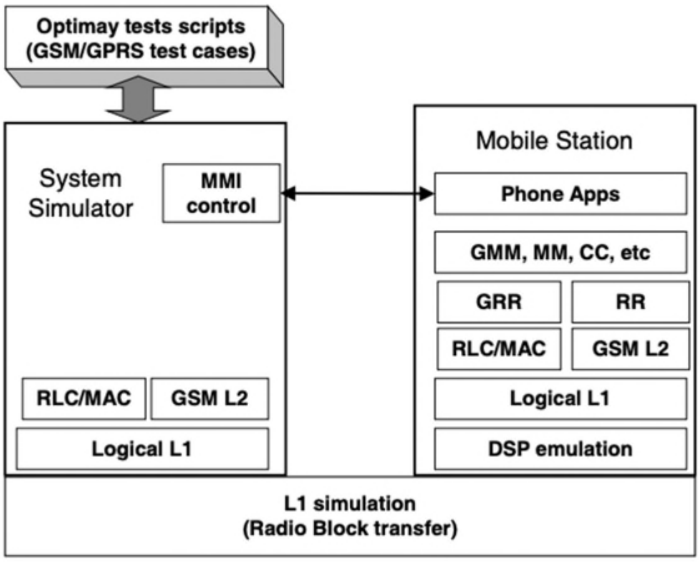


Fig. 2. GSM/GPRS test environment

[14] Olaf Bergengruen, *UMTS Terminal Testing: A Practical Perspective*, D. Hogrefe and A. Wiles (Eds.): TestCom 2003, LNCS 2644, pp. 10-19 (2003), *available at* https://link.springer.com/content/pdf/10.1007/3-540-44830-6_2.pdf, at Figs. 2-3 (last visited May 16, 2019).

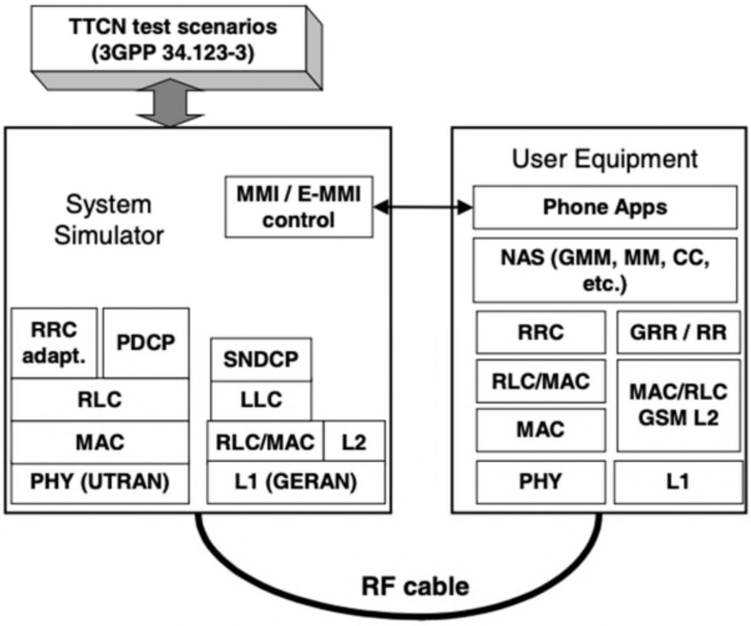
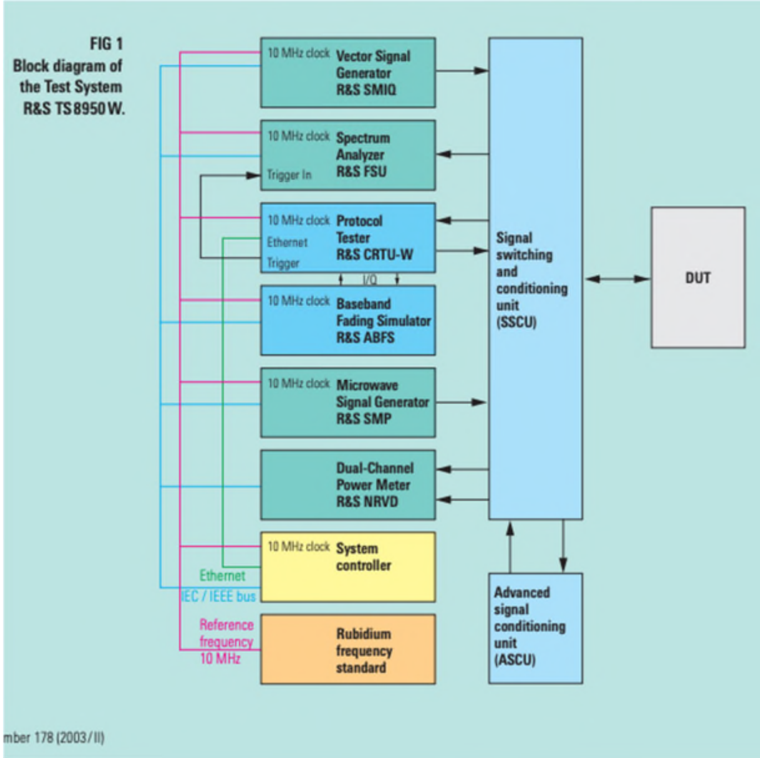


Fig. 3. The 3GPP Test Model (adapted from 3GPP TS 34.123-3)

179. For example, Rohde & Schwarz offered a test system for WCDMA in 2003 called the TS8950W, as can be seen in the figure below.[15]

[15] WCDMA Test System R&S TS8950W (2003), *available at* https://cdn.rohde-schwarz.com/pws/dl_downloads/dl_common_library/dl_news_from_rs/178/n178_TS8950W.pdf at 2 (last visited May 16, 2019).



180. Referring to the above figure, one can observe a "DUT" or device under test, which is the mobile unit. One can also observe the "baseband fading simulator" which would act as a channel simulation for fading (providing an adaptation of a channel characteristic including attenuation), and a protocol tester / emulator. Additional details for Rohde-Schwarz compliance test equipment can be found associated with the TS7100 and CMU200, as shown in the below figure.[16]

[16] News from Rohde & Schwarz (2000) *available at* https://scdn.rohde-schwarz.com/ur/pws/dl_downloads/dl_common_library/dl_news_from_rs/magazin/News169_englisch_72dpi.pdf, at Fig. 2 (last visited May 16, 2019) ("News from Rohde & Schwarz").

FIG 2 TS7100 in low-profile rack configuration

TS 7100 in production

The production test platform is made up of the following standard components:

- Multistandard Universal Radio Communication Tester CMU 200
- Test System Versatile Platform TSVP
- Generic test software library (GTSL)
  - TestStand test sequence control
  - UUT power supply

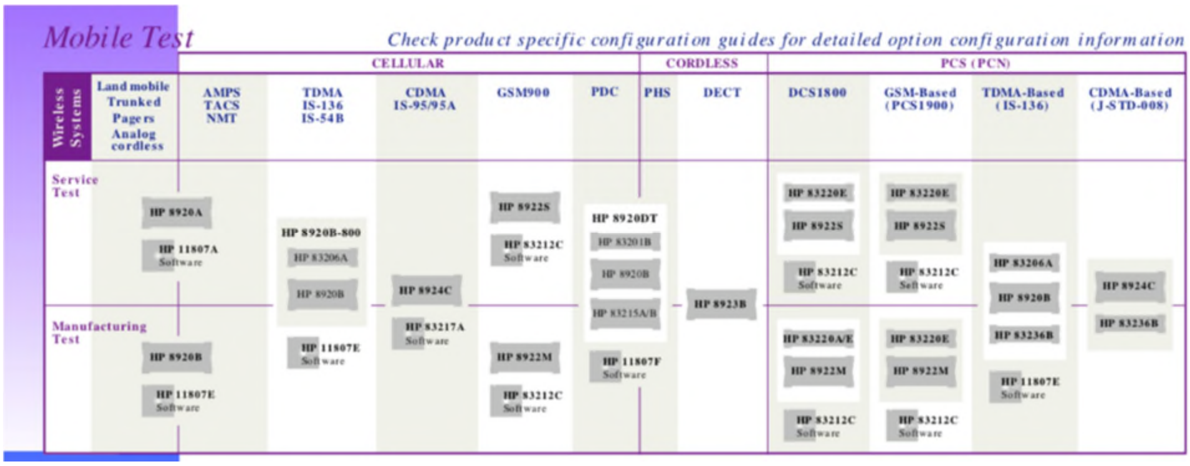
Just 80 cm high in the low-profile rack configuration (FIGs 2 and 3), TS 7100 can be set up as a two-channel system fcr the simultaneous testing of two mobile phones. In this case, the system components are fitted on both sides, and the rack can even be placed under the conveyor belt of a production line. Alternatively, a 130 cm conventional, high-profile rack with components fitted only on one side is available (FIG 4).

Number 169 (2000/IV)

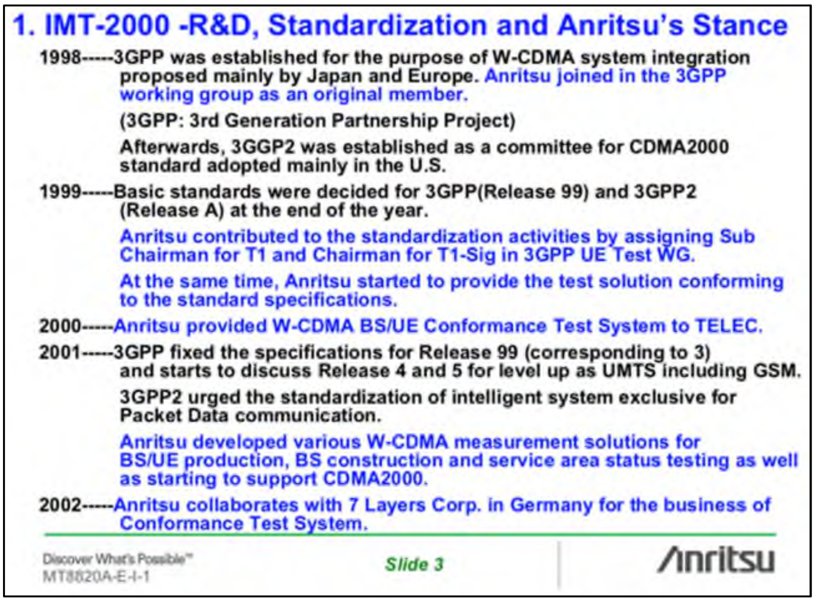
181. By 2003, Rohde & Schwarz had deployed over 1000 manufacturing tests systems worldwide to support compliance testing and manufacture testing. News from Rohde & Schwarz at 4 ("Rohde & Schwarz can look back on wide-ranging, international experience in project handling, having supplied more than 1000 production test systems for mobile phones.").

182. Other test-equipment vendors were active in the space as well at the time of the priority date of the '330 Patent. For example, Hewlett Packard had many variants of mobile test equipment for conformance testing of mobile phones in 1995, as shown below.[17]

[17] RF Test Sets for Wireless Communications, Hewlett Packard (1995) *available at* https://literature.cdn.keysight.com/litweb/pdf/5966-0046E.pdf?id=1000031836:epsg:dow, at 3 (last visited May 16, 2019).



183. Another vendor, Anritsu, provided a significant number of mobile test devices as well by 2003. A history of Anritsu's activity is depicted below.[18] This history also suggests that the vendors had close interaction with the standards development process so as to aid in the design of the test equipment.



1. IMT-2000 -R&D, Standardization and Anritsu's Stance

1998-----3GPP was established for the purpose of W-CDMA system integration proposed mainly by Japan and Europe. Anritsu joined in the 3GPP working group as an original member.

(3GPP: 3rd Generation Partnership Project)

Afterwards, 3GGP2 was established as a committee for CDMA2000 standard adopted mainly in the U.S.

1999-----Basic standards were decided for 3GPP(Release 99) and 3GPP2 (Release A) at the end of the year.

Anritsu contributed to the standardization activities by assigning Sub Chairman for T1 and Chairman for T1-Sig in 3GPP UE Test WG.

At the same time, Anritsu started to provide the test solution conforming to the standard specifications.

2000-----Anritsu provided W-CDMA BS/UE Conformance Test System to TELEC.

2001-----3GPP fixed the specifications for Release 99 (corresponding to 3) and starts to discuss Release 4 and 5 for level up as UMTS including GSM.

3GPP2 urged the standardization of intelligent system exclusive for Packet Data communication.

Anritsu developed various W-CDMA measurement solutions for BS/UE production, BS construction and service area status testing as well as starting to support CDMA2000.

2002-----Anritsu collaborates with 7 Layers Corp. in Germany for the business of Conformance Test System.

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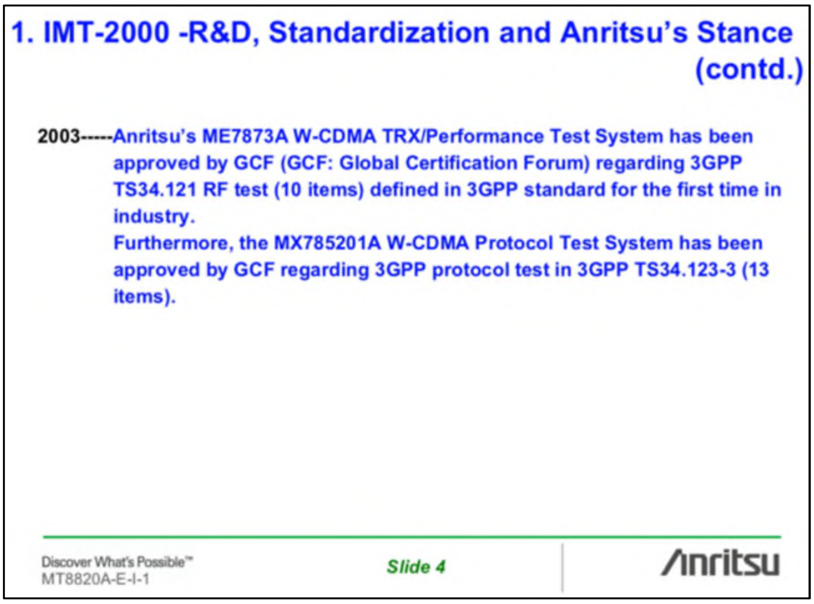
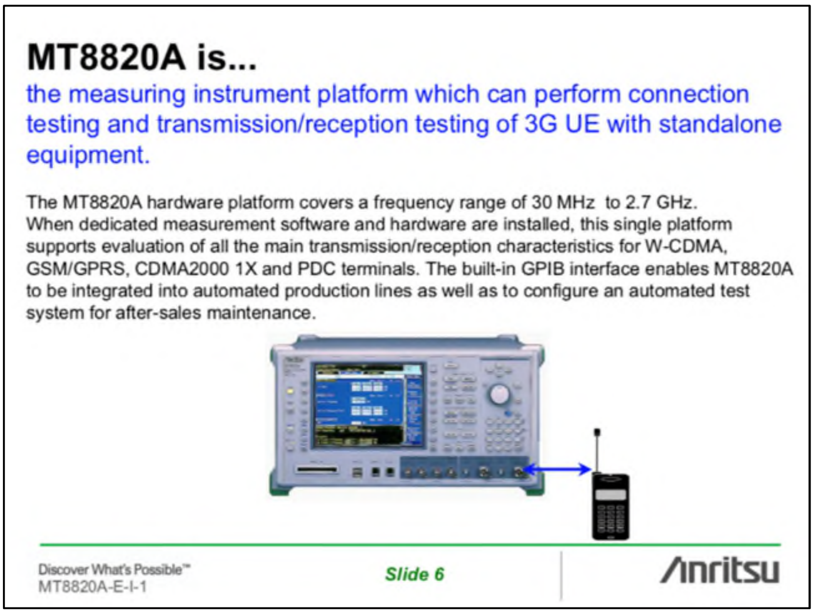
MT8820A-E-I-1

Slide 3

Anritsu

[18] Product Information, MT8820A Radio Communication Analyzer, Anritsu (2003) *available at* https://dl.cdn-anritsu.com/en-us/test-measurement/files/Product-Introductions/Product-Introduction/MT8820A_EI1500.pdf, at 4-5 (last visited May 16, 2019).





184. As can be seen from the above figures, the MT8820A supports many wireless standards including CDMA2000, W-CDMA, and GSM/GPRS. It also includes a "GPIB" port, which a POSITA would have known is for interfacing with a controller to automate the testing arrangement. To perform the WCDMA and CDMA2000 handover tests, the MT8820A would require including multiple base stations or sectors, and perform attenuation of the signals of each to adjust the relative power levels for the required tests, within a single integrated enclosure.

185. Another such system for testing a mobile unit within a mobile communications system is described in Spirent AirAccess C2K CDMA Network Emulator Operations Manual ("AirAccess"), published in 2001. This manual is also cited as a grounds for invalidity below. *See infra* Section XI.B. Another later, but substantially similar, version of this emulator is cited in Mobility's infringement theories, despite largely having been prior art. *See, e.g.*, '330 Patent Infringement Contentions at 5, 13, 16, 19-22, 25-29, 31, 33-34.

6. Academic and Industry Research for Wireless using Network Emulators

186. As disclosed in the '330 Patent, the NIST Net Emulator provides for the emulation of wireline network impairments including delay and jitter. '330 Patent at 5:60-6:2; NIST Net at Abstract. The inventors of the '330 Patent did not conceive or contribute to NIST Net development, but were apparently aware of its use based upon their general industry awareness at the time of the alleged invention of the '330 Patent. As discussed in detail below, *see, e.g.*, Section XI.A.4 below, a paper describing the development of NIST Net was published as "NIST Net – A Linux-based Network Emulation Tool," by Mark Carson and Darrin Santay published July 2003, and explicitly discloses the use of their emulator with wireless systems and its widespread use in the industry. NIST Net at 125. In fact, by 2003, NIST Net had been obtained by nearly 20,000 people and had been used extensively in industry and academic research. NIST Net at 112, 125.

187. I performed a brief search for academic papers referencing wireless systems and NIST Net, and determined there were many tens or more. An example of some of these state of the art papers include:

- Shelley Zhuang et al., *Host Mobility Using an Internet Indirection Infrastructure*, Berkeley, June 2002.[19]

[19] Shelley Zhuang et al., *Host Mobility Using an Internet Indirection Infrastructure*, Report No. UCB/CSD-2-1186, Computer Science Division (EECS), University of California, Berkeley (June 2002), *available at* https://www2.eecs.berkeley.edu/Pubs/TechRpts/2002/CSD-02-1186.pdf (last visited May 16, 2019).

- This paper includes Mobile IP protocols, mobile hosts in the form of GPRS, 3G, 802.11, for handoffs, and using NIST Net as part of its test system.

- Markku Kojo et al., *Seawind: a Wireless Network Emulator*, Proceedings of 11th GI/ITG Conference on Measuring, Modelling and Evaluation of Computer and Communication Systems (2001).[20]

  - This paper discusses emulating wireless networks such as GPRS and 802.11 and discusses handovers. This paper also discusses using the NIST Net and ONE emulators, *see, e.g.*, Sections XI.A.3 and XI.A.4 below, for implementation of their emulator.

- Yongguang Zhang et al., *An Integrated Environment for Testing Mobile Ad-Hoc Networks*, Proceedings of the 3rd ACM international symposium on Mobile ad hoc networking & computing (2002).[21]

  - This paper discuses using the NIST Net and ONE emulators for implementation of its research system. Additionally, this paper describers using RF attenuators to simulate path loss between the wireless nodes.

188. Based upon the disclosures of NIST Net and the derivative works mentioned above, as well as the numerous other examples of the use of NIST Net in academic and industry papers determined during my search for publications at the time, it is my opinion that it was a commonly known approach by one of ordinary skill in the industry to use a wireline network emulator (such as NIST Net or ONE) in combination with radio frequency network simulators to investigate overall protocol performance such as that of TCP/IP in a cellular or other wireless system.

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[20] Markku Kojo et al., *Seawind: a Wireless Network Emulator*, Proceedings of 11th GI/ITG Conference on Measuring, Modelling and Evaluation of Computer and Communication Systems (2001), *available at* http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=9B90D4454FEFFF55A4F12147F6E12B8B?doi=10.1.1.2.5403&rep=rep1&type=pdf (last visited May 16, 2019).

[21] Yongguang Zhang et al., *An Integrated Environment for Testing Mobile Ad-Hoc Networks*, Proceedings of the 3rd ACM international symposium on Mobile ad hoc networking & computing, p. 104-111 (2002), *available at* http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.464.31&rep=rep1&type=pdf (last visited May 16, 2019).

IX. SUMMARY OF THE ASSERTED PATENTS

A. The ’417 Patent

189. The ’417 Patent provides that for a mobile system architecture to function adequately the mobile node, or host, needs “some way … to let other nodes know where the mobile node can be reached while the host is moving or located away from home. In accordance with a typical mobile networking protocol, a mobile node registers with a home agent so that the home agent can remain a contact point for other nodes that wish to exchange messages or otherwise communicate with the mobile node as it moves from one location to another.” ’417 Patent at 1:37-44. “According to this architecture, a mobile node remains in contact with a communication network by repeatedly tearing down old connections and establishing new connections with a new base station as the host moves from one cell to another.” *Id.* at 1:31-35.

190. The ’417 Patent indicates that registration delays and associated information losses are a problem. Specifically, they provide:

> registration delays and associated information losses can still represent significant obstacles for wireless communications involving a mobile node. This stems mainly from the inevitable delay associated with the setting up of a new communication link each time the mobile node is handed off from one foreign agent to another. The setup requires time for the network to negotiate protocol details, establish communication rates, and decide the applicable error-handling approaches to be employed. These should each be resolved as a prelude to establishing the actual connection for the exchange of data.

Id. at 2:20-30.

191. In particular, the ’417 Patent states that in “conventional systems and devices, the setting up [of a new communication link] typically must await the arrival of the mobile node in the predefined region of coverage for the foreign agent to which the mobile node is to be handed off.” *Id.* at 2:30-33. It further states that “[d]epending upon the mobile network configuration, the

time required for registration can rival the time in which the mobile node dwells within a given cell coverage area. Moreover, data packets may be lost if they arrive for the mobile node during the time in which the setup is being worked out." *Id.* at 2:33-38.

192. The conventional systems, which include various versions of the standardized Institute of Electrical and Electronics Engineers ("IEEE") 802.11 ("Wi-Fi") standard, as well as various versions of the 2G, 2.5G and 3G cellular radio link systems standardized by the 3rd Generation Partnership Project ("3GPP") worldwide standards setting organization, used access points or base stations to communicate with mobile nodes within a region of coverage area, or region served by the access point of base station. To permit a mobile node to move from one cell's coverage area to an adjacent cell's coverage area, the access points or base stations were positioned so that their coverage areas overlapped.

1. <u>The Alleged Invention of the '417 Patent</u>

193. The '417 Patent characterizes "the present invention" as providing a preemptive and predictive solution in which ghost entities cause communication network resources to be allocated proactively rather than reactively. Specifically, it states:

> The present invention provides a preemptive and predictive solution for communications in wireless communications networks. More particularly, the present invention provides two different types of ghost-entities that can be used individually or jointly in setting up a wireless connection between a mobile node and a foreign agent. The ghost entities can act on behalf of a wireless node and a foreign agent. They can determine and use predicted information to improve the performance of wireless communications, especially those involving a mobile node moving at moderate or high speeds. As explained herein, the ghost entities cause communication network resources to be allocated proactively rather than reactively.

'417 Patent at 2:42-54.

194. The conventional cellular systems caused resources to be allocated "reactively" because they measure signal strengths at the mobile node's current location and allocate resources

only after the mobile node has physically arrived in the coverage area of the next cell. Likewise, the existing Mobile IP systems caused resources to be allocated "reactively" because they could only register with the next foreign agent and allocate resources to the mobile node after an IP link was created, which required the mobile node to be physically present in the coverage area of the next foreign agent.

195. In contrast, the "ghost-mobile node" of the '417 Patent is described in the specification as follows:

- "ghost-mobile node can be configured to register the mobile node and allocate resources for communicating with the mobile node according to a predicted future state of the mobile node" (*id.* at 2:58-61);
- "the ghost-mobile node can be instantiated in at least one additional wireless network node proximate to the predicted future location of the mobile node" (*id.* at 2:61-63);
- "the ghost-mobile node can be configured to predict the future location of the mobile node" (*id.* at 2:64-65);
- "the ghost-mobile node also can buffer data packets intended for the mobile node and sent by a correspondent node" (*id.* at 2:65-67);
- "the ghost mobile node can serve as a virtual repeater capable of registering and allocating communication resources by predicting where the mobile node's next handoff will occur as the mobile node moves relative to the communication network's nodes" (*id.* at 3:61-65);
- "the ghost mobile node signals the foreign agent before the mobile node arrives in the predefined region based upon the prediction of the mobile node's future state" (*id.* at 6:35-38);
- "the ghost mobile node can perform the function of determining the closest foreign agent" (*id.* at 6:55-56);
- "the ghost mobile node can extrapolate from the current location and predicted future locations of the mobile node [*e.g.*, using GPS and a Kalman filter]" (*id.* at 7:7-22); and
- "the ghost mobile node forges registration packets on behalf of the mobile node" / "the ghost mobile node can replicate the registration request, handle the creation of tunnels, and replicate authentication and authorization information from the mobile node, thus acting on behalf of the mobile node is in range of a next foreign agent" (*id.* at 9:45-50, 10:1-6).

196. Furthermore, the "ghost foreign agent" of the '417 Patent is described in the specification as follows:

- "the ghost foreign agent can be configured to provide an advance notification to the mobile node of a presence of a next wireless network node proximate to the predicted future location of the mobile node" (*id.* at 3:3-6);

- "the ghost foreign agent advertises the foreign agent's presence in the communication network using a neighboring foreign agent. The ghost-foreign agent can thus make a mobile node aware of a corresponding foreign agent's presence in a communication network before the mobile node actually arrives in the physical region covered by the foreign agent" (*id.* at 4:1-7);

- "the ghost foreign agent transmits an advertisement notifying the mobile node of the existence of a next foreign agent, transmitting the advertisement from a foreign agent currently connected with the mobile node" (*id.* at 10:17-21);

- "Each foreign agent creates ghost-foreign agent instances at the vicinity of other foreign agents. A ghost-foreign agent results in a virtual augmentation of the signal strength of a certain foreign agent, so that the signal strength appears to have increased and the coverage area appears to have been augmented by a certain factor. Indeed, a ghost-foreign agent appears to increase the amount of resources available for facilitating communication among interconnected communication networks" (*id.* at 11:6-14); and

- "the ghost foreign agent can thus function as passive repeaters of the operations of the corresponding foreign agent." (*id.* at 11:25-27).

2. Prosecution of the '508 Patent

197. It is my understanding that, because the '417 Patent is a continuation of the '508 Patent, the prosecution history of the '508 Patent is equally relevant to the '417 Patent. During the prosecution of the '508 Patent, the patent applicants distinguished the "ghost mobile node" from traditional mobile nodes by stating the following:

> Applicants emphasize the distinction between ghost mobile nodes and mobile nodes of the present invention. The Examiner rejected the ghost mobile node, regardless of its physical embodiment, since it is "a virtual node or a set of software instructions running on the mobile node itself." The fact that the ghost mobile node could be a virtual node is not relevant to the operative role of the ghost mobile node as opposed to the mobile node. An estimated location of the mobile node based on GPS data can be utilized along with trajectory and speed information of the mobile node *to predict the future*

> *geographical state*. Based on a predicted future state, one or more ghost mobile nodes can be created that are capable of representing the mobile node, and fulfilling actions traditionally requiring the physical presence of the mobile node, namely registering and allocating communication resources. The ghost mobile node is capable of registering and allocating communication resources *before* the mobile node physically arrives in a geographical state.

'508 Patent File History, Response to Office Action dated Apr. 6, 2009, at 12 (emphasis in the original).

198. The use of a "ghost mobile node" to first predict a future location of the mobile node and then to register and allocate resources to the mobile node *before* the mobile node physically arrives in the predicted future geographical location was the inventive concept set forth in the '508 and '417 Patents. Said differently, rather than using the conventional approaches in which the mobile node *reacts* by handing-off the connection *after* the mobile arrives in the next geographical state (*i.e.*, the coverage area of the next foreign agent), the alleged invention predicts where the mobile node will be at some time in the future and registers and allocates resources *before* the mobile node arrives in the next geographical state. By using a "ghost mobile node" to proactively and preemptively *pre-register* the mobile node based on a future location prediction, the alleged invention addresses the problem of the time required for registration rivalling the time the mobile node dwells within a given cell coverage area and packets being lost during the registration setup time.

3. Predictive Mobility Prior Art

199. In the mid-1990s, with the rise of the internet, cellular communications, and wireless networking, a number of engineers and scientists were developing improved mobile systems to allow users to access data efficiently. In this regard, a number of proposals were made to improve upon the Mobile IP standard using predictive mobility management schemes to support service pre-connection connection and resource pre-arrangement.

200. One such scheme was proposed by George Liu of Ericsson and the KTH Royal Institute of Technology in the 1990s. Dr. Liu published a paper titled "A Virtual Distributed System Architecture for Supporting Global-distributed Mobile Computing" ("the Liu paper"), and he was issued U.S. Patent No. 5,825,759 ("the Liu patent") on a network architecture for supporting data mobility for users of mobile networks. The Liu paper and Liu patent are discussed in more detail below.

201. Another such scheme was proposed Youngjune Gwon in US Patent Publication No. 2002/0131386 ("Gwon I") and U.S. Patent Publication No. 2003/0016655 ("Gwon II"). Gwon II incorporates Gwon I by reference. *See* Gwon II at ¶¶ 1, 61. Both Gwon I and Gwon II disclosed methods for predicting the mobility of mobile nodes in wireless networks to enable fast route pre-establishment and reduced packet latency. The Abstract of Gwon I provides:

> Disclosed are methods for predicting the mobility of mobile nodes in third generation and beyond wireless, mobile access Internet protocol-based data networks embodying IETF Mobile IP support, as well as in wireless LANs. Conventional Mobile IP mobility detection is replaced with deterministic, stochastic, and/or adaptive methods to predict the mobility of a mobile node in the network employing network logic layer (L3) packet latency characteristics. The method is useful for providing pre-notification that a communication hand-off condition is imminent to enable fast route pre-establishment and reduced packet latency, and for optimizing quality of service by facilitating selection of best base station transceiver in overlapping cell environments, among other applications."

Gwon I at Abstract.

202. Yet another predictive mobility management scheme is described in U.S. Patent No. 6,385,454 naming Paramvir Bahl and Tong Liu as Inventors and Microsoft Corporation as the Assignee ("Bahl"). Bahl discloses a system and method for managing resources in a wireless cellular communications system wherein both intra-cell and inter-cell trajectory of the mobile unit are monitored and subsequently used to predict the path it will take for the purposes of reserving

bandwidth and setting up routes ahead of time, reducing hand-off latencies, and relieving congestion in the cells along this predicted path. The Abstract of Bahl provides:

> Wireless networks require efficient mobility management to cope with frequent mobile handoff and rerouting of connections. The invention treats this problem by developing a hierarchical prediction engine that employs approximate pattern matching and Kalman filtering techniques to yield an accurate prediction of both the immediate next cell to be entered by the mobile and the overall or global route of the mobile unit in the wireless cellular network. The prediction of the mobile's future movement is used by the network to reserve resources, relieve congestion, reduce latency, and optimize the establishment of routes in the wireless cellular network.

Bahl at Abstract.

203. A further mobility prediction scheme is described in an article by Ming-Hsing Chiu & Mostafa A. Bassiouni, titled “Predictive Schemes for handoff Prioritization in Cellular Networks Based on Mobile Positioning,” (“Chiu”) published in March 2000. The predictive mobility scheme disclosed in Chiu, called predictive channel reservation (PCR), works by sending reservation requests to neighboring cells based on extrapolating the motion of mobile stations (MS’s). For example, Chiu at provides:

> In the PCR scheme, channel allocation decisions are based on the prediction (extrapolation) of the motion of MS’s. Each MS periodically measures its position and orientation. The position measurement is made by using GPS, GSM, or any other technology, and the orientation can be easily obtained from the vector of two consecutive position measurements taken over a short time … Based on the projected path, the next cell (one of the neighboring cells of the current cell) that the mobile is heading to is determined. When the MS is within a certain distance from the next cell, the current BS sends a reservation request to the new BS in order to pre-allocate a channel for the expected handoff event.

Chiu at 512.

204. A further mobility prediction scheme is described in U.S. Patent Publication No. 2002/0045450 naming Keiichi Shimizu, Shuji Ito, and Koichi Ishibashi as Inventors and

Mitsubishi Denki Kabushiki Kaisha as the Assignee ("Shimizu"). The Abstract of the Shimizu patent application provides:

> In accordance with a handoff method, when a handoff of mobile terminal equipment from a previous foreign agent to a new foreign agent is detected, the mobile terminal equipment is doubly registered with either a home agent or a gateway foreign agent so that the mobile terminal equipment is associated with both the previous foreign agent and the new foreign agent. During the handoff, either the home agent or the gateway foreign agent determines whether or not an IP packet destined for the mobile terminal equipment is of real-time traffic, and then bicasts the IP packet to both the previous foreign agent and the new foreign agent if the IP packet is of real-time traffic, and buffers the IP packet otherwise. When the handoff is completed, the regional registration with either the home agent or the gateway foreign agent is updated so that the mobile terminal equipment is associated only with the new foreign agent. Either the home agent or the gateway foreign agent then transfers IP packets of non-real-time traffic buffered therein to the new foreign agent.

Shimizu at Abstract.

205. I understand that Verizon provided Invalidity Charts to Plaintiff relating to these predictive mobility references. I incorporate these charts by reference into this Report.

4. Priority Date of the ’417 Patent

206. I am informed that the ’417 Patent claims a priority date of July 31, 2003, corresponding to the filing date of Provisional Application No. 60/491,436.

5. The Asserted Claims of the ’417 Patent

207. Below I have reproduced Claims 1, 4, and 7 of the ’417 Patent.

‘417 Claim 1
[‘417, 1(a)] A system for communicating between a mobile node and a communication network; the network having at least one communications network node that is interconnected using a proxy mobile internet protocol (IP), comprising:
[‘417, 1(b)] at least one mobile node;
[‘417, 1(c)] at least one home agent;
[‘417, 1(d)] at least one foreign agent;
[‘417, 1(e)] a ghost-foreign agent that advertises messages to one of the mobile nodes indicating presence of the ghost-foreign agent on behalf of one of the foreign agents when the

mobile node is located in a geographical area where the foreign agent is not physically present; and	
[‘417, 1(f)] a ghost-mobile node that creates replica IP messages on behalf of a mobile node, the ghost-mobile node handling signaling required to allocate resources and initiate mobility on behalf of the mobile node, the ghost-mobile node triggering signals based on a predicted physical location of such mobile node or distance with relation to the at least one foreign agent.	
‘417 Claim 4	
[‘417, 4(a)] The system of claim 1, wherein the at least one ghost-mobile node is a proxy element for the at least one foreign agent and the at least one mobile node,	
[‘417, 4(b)] the at least one ghost-mobile node triggering registration based on a distance to a foreign agent by relaying security and shared secrets from a mobile node, and at least one advertisement message from a foreign agent in a vicinity of the ghost-mobile node.	
‘417 Claim 7	
[‘417, 7(a)] A method, in a mobile node, for speeding handover, comprising the steps of:	
[‘417, 7(b)] updating, in a mobile node, a location in a ghost mobile node;	
[‘417, 7(c)] determining a distance, in the ghost mobile node in communication with the mobile node, to a closest foreign agent with which the mobile node can complete a handover;	
[‘417, 7(d)] submitting on behalf of the mobile node, from the ghost mobile node, a registration to the foreign agent to which the mobile node is going to complete the handover; and	
[‘417, 7(e)] upon completing the handover, updating a registration in the mobile node.	

208. I have been informed that Claim 7 of the ’417 Patent was issued by mistake by the U.S. Patent and Trademark Office. The prosecution history of the ’417 Patent demonstrates that Claim was withdrawn from consideration in a Response to a Restriction Requirement dated May 13, 2011, was never examined by the Examiner in any subsequent office actions, and was mistakenly included in the list of allowed claims in the Notice of Allowance. I am informed that the circumstances render Claim 7 unenforceable in this action. However, because Mobility Workx maintains its assertion of Claim 7 of the ’417 Patent, I provide my analysis regarding the invalidity of Claim 7 of the ’417 Patent herein out of an abundance of caution.

B. The ’330 Patent

209. According to the ’330 Patent, conventional wire-line emulators were, at the time of the ’330 Patent, not able to “account for characteristics of rapid mobility networks or complex signal propagation models” and “[a]s such, [they] [we]re not available or unable to model mobile

networks." ’330 Patent at 2:10-14. The ’330 Patent purports to "provide a method and system for modeling mobile networks . . . to model and test various mobile network configurations and scenarios." ’330 Patent at 2:18-22. In the system of the ’330 Patent, a mobile node is "configured to wirelessly communicate with" wireless network nodes, or emulated base stations. ’330 Patent at Claim 1. The controller of the ’330 Patent simulates motion of the mobile node "by dynamically adjusting the signal reception sensitivity and signal transmission strength of each wireless node." ’330 Patent at 2:25-28. When modeling motion of the mobile node, "[c]ommunications exchanged between the application and the mobile node can be monitored and tracked to study the behavior of the mobile network, including the effects of motion of the mobile node upon overall network performance." ’330 Patent at 2:28-32. More specifically, one purpose of the ’330 Patent is to "analyze[] and compare[]" "the strength of the signal received at the mobile node 125 . . . with the data throughput of each wireless node 105 over time" because "[s]uch an analysis can reveal hand-off rates between the wireless nodes 105." ’330 Patent at 7:22-26. Similarly, the ’330 Patent explains further that "by analyzing the data throughput of each wireless node, the handoff rate, or the rate at which the mobile node leaves the coverage area of one network node and enters the coverage area of another, can be determined. The signal strength as measured at the mobile node also can be monitored and compared with the attenuation function applied to the wireless nodes." ’330 Patent at 9:22-28.

210. In other words, the ’330 Patent is directed to a testing system for simulating a mobile node’s movement from one coverage area to another to wirelessly test the hand-off rate and hand-off performance of emulated base stations. Movement of the mobile node through the coverage areas is simulated through attenuation of the wirelessly transmitted signals.

1. Emulator Prior Art

211. In the mid-1990s, with the rise of the internet, cellular communications, and wireless networking, a number of engineers and scientists were developing improved mobile systems to allow users to access data efficiently as well as emulators and simulators to test those systems. A number of systems for emulating wireless communications using rapid mobility characteristics and complex signal propagation models were available at the time.

212. One such system was proposed by H. Brent Mount in 1999. Mr. Mount was issued U.S. Patent No. 6,272,337 ("Mount") on a system for testing a mobile communications system, including simulated movement of mobile nodes. The Abstract of Mount provides:

> A method and apparatus testing a mobile communications system includes a test control system, real mobile units, and an attenuator matrix controllable by the test control system to vary strengths of signals transmitted by the mobile units for receipt by the mobile communications system. By varying the attenuation of the signals communicated between the mobile units and the mobile communications system, the mobile units may be made to appear to be moving to the mobile communications system. Movement patterns of the mobile units may be stored in the test control system to control attenuation in the attenuator matrix.

Mount is discussed in more detail below.

213. Another such system for testing a mobile unit within a mobile communications system is described in Spirent AirAccess C2K CDMA Network Emulator Operations Manual ("AirAccess"), published in 2001. AirAccess emulates a mobile network and allows the operator to test communications between the mobile unit under test and the emulated base stations, including handoff. The overview of AirAccess provides:

> The AirAccess C2K CDMA Network Emulator is a scaleable performance analysis solution for CDMA terminal manufacturers and service providers. AirAccess combines powerful application software with a high-speed protocol processing engine to provide complete emulation of a multicell CDMA network.

AirAccess at 1.1.

214. Yet another such system was proposed by Yoram Rimoni in US Patent Publication No. 2002/0183054 (“Rimoni”). Rimoni disclosed a system and method of emulating a mobile communications system for testing mobile units. Rimoni is discussed in more detail below.

215. Yet another such system for emulating movement of the mobile node and testing handoff between the mobile unit and emulated base stations was proposed by HoShin Cho in Korean Patent Application Publication No. KR2001-0048715 (“Cho”), published on June 15, 2001. Cho is discussed in more detail below.

216. The ’330 Patent explains that the preferred emulator of its system is the NIST Net emulator. The NIST Net emulator is described in “NIST Net – A Linux-based Network Emulation Tool,” by Mark Carson and Darrin Santay, published in ACM SIGCOMM Computer Communications Review in July 2003. For example, the ’330 Patent states,

> The emulator **110** can be a hardware or a software network emulator. According to one embodiment of the present invention, the emulator **110** can be implemented as a software-based network emulator configured to emulate various performance scenarios such as tunable packet delay distributions, congestion and background loss, bandwidth limitation, and packet reordering and duplication. For example, the emulator **110**can be implemented using a computer system executing the National Institute of Standards and Technology (NIST) emulator.

’330 Patent at 5:60-6:2.

217. The Abstract of NIST Net provides that it is “a tool to facilitate testing and experimentation with network code through emulation. NIST Net enables experimenters to model and effect arbitrary performance dynamics (packet delay, jitter, bandwidth limitations, congestion, packet loss and duplication) on live IP packets passing through a commodity Linux-based PC router.” NIST Net at Abstract.

218. Moreover, NIST Net explains that it was easily and widely accessible as "[t]housands of people throughout the world ha[d] successfully installed and used the emulator for a wide variety of projects, even those with no prior experience with Linux. It has proven particularly useful in academic settings for class laboratories and student research projects." NIST Net at 112. In particular, NIST Net explains that in 2003, "[s]ince its initial release, NIST Net ha[d] been obtained by nearly twenty thousand people around the world, and has been used for a wide variety of testing purposes, including for voice over IP, mobile network emulation, adaptive video transmissions, satellite and underseas radio link emulation, and interactive network gaming." NIST Net at 125. Further, NIST Net explains that its code, documentation, and calibration results "are all public domain and are available through its web site." NIST Net at 125. NIST Net is described in further detail below.

219. Finally, another such system for emulating attributes of a packet-based wired communications network was proposed by Mark Allman, Adam Caldwell, and Shawn Ostermann in "ONE: The Ohio Network Emulator," published August 18, 1997. ONE explains that it "models the routers and intervening network by delaying packets arriving on one network interface before forwarding them to the other network. *ONE* also provides congestion loss according to its configuration. The delay a packet experiences is based on the packet size and the configuration parameters given by the user." ONE at 2. As explained above in Section VIII.B.6., ONE was commonly used in academic and industry research before the priority date of the '330 Patent. ONE is discussed in more detail below.

220. I understand that Verizon provided Invalidity Charts to Plaintiff relating to these wireless network emulation references. I incorporate these charts by reference into this Report.

2. <u>Priority Date of the ’330 Patent</u>

221. I am informed that the ’330 Patent claims a priority date of July 31, 2003, corresponding to the filing date of Provisional Application No. 60/491,637.

3. <u>The Asserted Claims of the ’330 Patent</u>

222. Below I have reproduced Claims 1, 3, and 4 of the ’330 Patent.

‘330 Claim 1
[‘330, 1(a)] A system for emulating mobile network communications comprising:
[‘330, 1(b)] a plurality of fixedly-located wireless network nodes configured to variably adjust wireless communication characteristics;
[‘330, 1(c)] at least one mobile node configured to wirelessly communicate with selected ones of said plurality of wireless network nodes;
[‘330, 1(d)] a network emulator communicatively linked to each of said plurality of wireless network nodes, said network emulator configured to emulate attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network, the emulated attributes comprising at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication; and
[‘330, 1(e)] a controller communicatively linked to each of said plurality of wireless network nodes, said controller configured to control the wireless communication characteristics of each of said plurality of wireless network nodes to simulate, without changing operating parameters of said at least one mobile node, different wireless communication conditions experienced by said at least one mobile node in actual operation.
‘330 Claim 3
[‘330, 3(a)] The system of claim 1, wherein said wireless communication characteristics include a signal reception sensitivity.
‘330 Claim 4
[‘330, 4(a)] The system of claim 1, wherein said wireless communication characteristic includes at least one of signal transmission strength, signal-to-noise ratio (SNR), and bit error rate (BER).

X. CLAIMS 1, 4, AND 7 OF THE ’417 PATENT ARE INVALIDATED BY THE PRIOR ART

A. The Liu Paper and Liu Patent Each Anticipate the Asserted Claims or Render Them Obvious in View of Gwon

1. <u>The Liu Paper</u>

223. The Liu paper is dated December 28, 1994, and was published in 1995. Therefore, it qualifies as prior art under 35 U.S.C. § 102(b) (pre-AIA). It was deposited in the National Library

of Sweden in 1995. *See* http://libris.kb.se/bib/1991819?vw=full. It is my understanding that the publications of the National Library of Sweden can be searched electronically by going to the following website: https://libris.kb.se/bib/.

224. I am informed that records on the site are stored in the MARC21 format and can be searched by author, subject, and/or title.

225. The Liu paper was not cited or considered during the prosecution of either the ’508 Patent or the ’417 Patent, but I am informed that Dr. Hernandez had a copy of this paper in his files and did not disclose it to the U.S. Patent and Trademark Office.

226. The Abstract of the Liu paper provides:

> This paper describes a Mobile-distributed System Architecture for supporting wireless data accessing. The concept of a *Mobile-Floating Agent (or Mobility Agent)* with it's notions of service/resource mobility and service pre-assignment is proposed. This Agent utilizes a mobility prediction algorithm to enable a mobile computer to be aware of its current location and potential locations (available links). When the mobile computer moves, it predicts the links and data services offered at the new location, prefetches and caches its critical data with hierarchical caching strategies. As the computer is moving to the new location, it dynamically adapts to the changing computing environments and makes data accessible with virtually the same efficiency as at the previous location (subject to link capacity).

Liu at Abstract (emphasis in original).

227. The Liu paper further provides:

> In this paper, we present a virtual-distributed network mobility architecture with a notion of *Mobile Floating Agent (or Mobility Agent)* to support data and service mobility. The principal contribution of our paper is to combine the Mobile Floating Agent functions with a novel predictive mobility management scheme to support *service pre-connection* and *resource pre-arrangement.*

Id. at 5 (emphasis in original).

228. The Liu paper discloses a home agent, foreign agent, mobile node, ghost foreign agent, and ghost mobile node, as shown in Figure 7 reproduced below (which I have annotated in color):

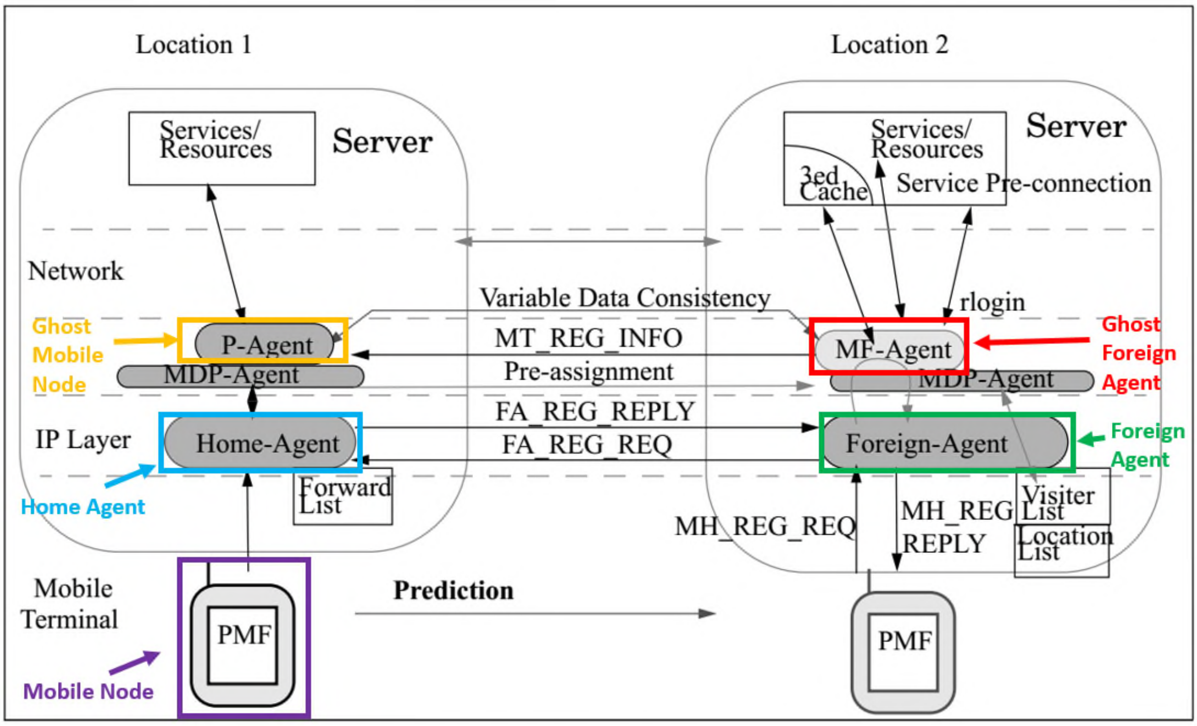


FIGURE 7. Mobile Floating (MF) Agent concept

Liu paper at 19.

2. The Liu Patent

229. The Liu patent, U.S. Patent No. 5,825,759, issued on October 20, 1998, from an application filed on July 24, 1995. It therefore qualifies as prior art under 35 U.S.C. § 102(b) (pre-AIA). The Liu patent was not cited or considered during the prosecution of the '417 Patent.

230. The Abstract of the Liu patent provides:

> A full mobility data network architecture and method supports global wireless mobile data accessing. A Mobile Distributed System Platform, a mobility agent and a mobile-floating agent are provided for supporting service and resource mobility, and for distributing network services and resources closer to mobile users. In one aspect of the invention, a predictive mobility management algorithm

> determines where a mobile user or terminal is likely to be. Mobile-floating agents are then established at these locations to permit pre-connection and pre-arrangement of network services and resources for use by the user upon arrival. This allows mobile networks to more intelligently and dynamically provide services to mobile users. The Mobile-Floating Agent scheme can be used, for example, to build a mobile virtual distributed home location register (HLR) and visitor location register (VLR) in personal communication networks (PCNs), in order to reduce the call set up time. It can also be used for “soft data structure handover” for mobile computing.

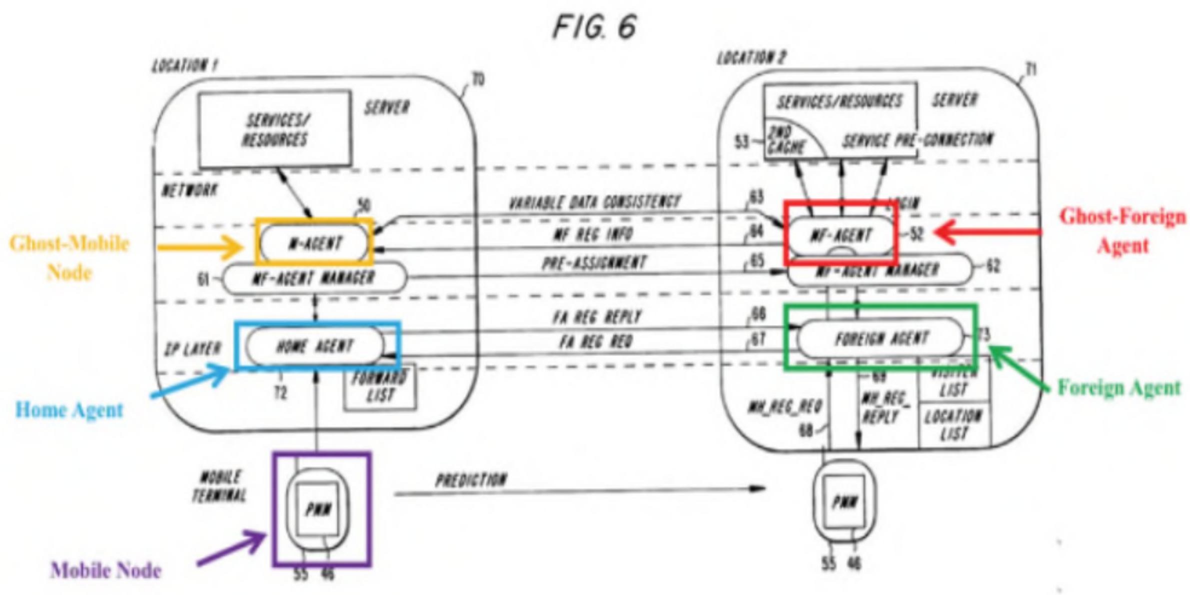
Liu patent at Abstract.

231. The Liu patent and the ’417 Patent similarly seek to address the problem of delays in mobile networks:

> It is therefore an object of this invention to dynamically provide service and resource mobility in mobile wireless Local Area Networks (LANs) and cellular networks. It is another object to improve mobile data access and performance while reducing user latency.
>
> SUMMARY
>
> The foregoing and other objects are accomplished through use of a mobile floating (MF)-agent protocol in a mobile database system. The invention provides methods and apparatus for accommodating the “mobile nature” of mobile users by offering service and resource mobility. This is accomplished through intelligent service pre-connection, resource pre-allocation, and data-structure pre-arrangement. By deploying MF-Agents to decouple network services (such as user authentication data, registration data, etc.) and resources from the underlying network and moving them to follow their mobile users, the database becomes virtually distributed and aware of the location of the users.
>
> By combining the Mobile-Floating agent functions with a method of predictive mobility management, the service and user data can be pre-connected and pre-assigned at the locations or cells to which the user is moving. This allows the users to immediately receive service and maintain their data structures with virtually the same efficiency as they could have at the previous location. It also provides "soft data structure handoff" capability.

Id. at 1:51-2:10; *see also* ’417 Patent at 2:20-38, 3:49-55.

232. The Liu patent discloses a home agent, foreign agent, mobile node, ghost-foreign agent, and ghost mobile node, as shown in Figure 6 reproduced below from the *inter partes* review petition filed by Unified Patents Inc. *See* Petition for *Inter Partes* Review of U.S. Patent No. 8,213,417, *Unified Patents Inc. v. Mobility Workx, LLC*, IPR2018-01150 (filed June 1, 2018).



Liu patent at Fig. 6.

3. <u>Gwon I</u>

233. U.S. Patent Publication No. US 2002/0131386 A1 ("Gwon I"), was published on September 19, 2002, from an application filed on January 26, 2001. It therefore qualifies as prior art under 35 U.S.C. §§ 102(a) and (e) (pre-AIA). Gwon I was not cited or considered during the prosecution of the '417 Patent. Gwon I discloses that:

> The mobile node 135 may identify available local routers using the Neighbor Discovery methodology described in RFC 2461 and the IETF Mobile IP version 6 draft document (section 10.4). Thus, the mobile node 135 may broadcast Router Solicitation messages to determine if any local routers are available, or may wait to receive unsolicited multicast Router Advertisement messages from available routers. . . . In either event, the mobile node will have

> identified new local router R2 with which to establish its new network connection.

Gwon I at ¶ 53.

4. Analysis—Claim 1

['417, 1(a)] A system for communicating between a mobile node and a communication network; the network having at least one communications network node that is interconnected using a proxy mobile internet protocol (IP), comprising:

234. Both the Liu paper and Liu patent each disclose a system for communicating between a mobile node and a communication network.

235. For example, the Liu paper describes a mobile virtual-distributed system for wireless data access to network services and resources when a mobile terminal moves. In particular, the Liu paper describes how connectivity from a home agent at a current location of the mobile terminal is transitioned to a remote host or router located at a new location in a wireless local area network or a cellular system as the mobile terminal changes location. *See, e.g.*, Liu paper at Abstract, 5-6, 17-20 & Fig. 7.

236. Likewise, the Liu patent describes the use of a mobile floating (MF)-agent protocol in a mobile database system that accommodates the "mobile nature" of mobile users by offering network service and resource mobility. This is accomplished through intelligent service pre-connection, resource pre-allocation, and data-structure pre-arrangement. By deploying MF-Agents to decouple network services (such as user authentication data, registration data, etc.) and resources from the underlying network and moving them to follow their mobile users, the database becomes virtually distributed and aware of the location of the users. *See, e.g.*, Liu patent at Abstract, 1:55-2:2, 5:55-61, 7:14-8:6, 16:44-16:61 & Figs. 6, 19, 21.

237. Both the Liu paper and Liu patent further disclose a network having at least one communications network node that is interconnected using a proxy mobile internet protocol.

238. For example, the Liu paper provides network services and resource distribution to a mobile device by employing proxy entities—the P-Agent and MF-Agent—to interconnect the mobile device to the network using Mobile IP (a mobile internet protocol). *See* Liu paper at Abstract, 17-20 & Fig. 7.

239. Similarly, the Liu patent provides network services and resource distribution to a mobile device by employing proxy entities—the M-Agent and MF-Agent—to interconnect the mobile device to the network using Mobile IP (a mobile internet protocol). *See* Liu patent at 2:11-34, 7:15-17 & Figs. 6, 7.

['417, 1(b)] at least one mobile node;

240. The Liu paper discloses at least one mobile node as mobile terminal. *See* Liu paper at 17-20 & Figs. 6, 7 (as annotated above).

241. The Liu patent discloses at least one mobile node as mobile terminal. *See* Liu patent at 6:4-7 & Fig. 6 (as annotated above).

['417, 1(c)] at least one home agent;

242. The Liu paper discloses at least one home agent, shown as the "Home-Agent" at Location 1 in Figure 7. *See* Liu paper at 19-20 & Fig. 7 (as annotated above).

243. The Liu patent discloses at least one home agent as "Home Agent 72" in Figure 6. *See* Liu patent at 2:15-21 & Fig. 6 (as annotated above).

['417, 1(d)] at least one foreign agent;

244. The Liu paper discloses at least one foreign agent, shown as the "Foreign-Agent" at Location 2 in Figure 7. *See* Liu paper 19-20 & Fig. 7 (as annotated above). The Foreign-Agent in the Liu paper meets the Court's definition of foreign agent ("a network node on a visited network that assists the mobile node in receiving communications") because it is on a visited network and

assists the mobile terminal (*i.e.*, the "mobile node") in the registration process, which allows the mobile terminal to receive communications at its new and predicted location. *See id.*

245. The Liu patent discloses at least one foreign agent as "Foreign Agent 73" in Figure 6. *See* Liu patent at 7:51-57 & Fig. 6 (as annotated above). The Foreign Agent 73 in the Liu patent meets the Court's definition of foreign agent ("a network node on a visited network that assists the mobile node in receiving communications") because it is on a visited network and assists the mobile terminal (i.e., the "mobile node") in the registration process, which allows the mobile terminal to receive communications at its new and predicted location. *Id.*; *see also id.* at 8:7-16.

['417, 1(e)] a ghost-foreign agent that advertises messages to one of the mobile nodes indicating presence of the ghost-foreign agent on behalf of one of the foreign agents when the mobile node is located in a geographical area where the foreign agent is not physically present;

246. The Liu paper and Liu patent each disclose a ghost-foreign agent that advertises messages to one of the mobile nodes indicating presence of the ghost-foreign agent on behalf of one of the foreign agents when the mobile node is located in a geographical area where the foreign agent is not physically present. In particular, both the Liu paper and Liu patent disclose an MF-Agent, as shown in Figure 7 of the Liu paper and MF-agent 52 in Figure 6 of the Liu patent.

247. The MF-Agent of the Liu paper satisfies the Court's definition of ghost-foreign agent ("a virtual node corresponding to a foreign agent that can make a mobile node aware of the corresponding foreign agent's presence in a communication network proximate to the predicted future location of the mobile node") because it is a virtual node implemented as a software process or processes, executing on a remote fixed host or router that includes a foreign agent and communicates and pre-connects with local host resources. *See* Liu paper at 17, 20 & Fig. 7. The virtual distributed system architecture of the Liu paper makes use of a location prediction function that can be performed automatically by a mobile prediction algorithm (*see id.* at 16), and the MF-

Agent is assigned to a location near the predicted future location of the mobile node. *Id.* at 17, 20 & Fig. 7.

248. Similarly, the MF-agent 52 of Liu patent satisfies the Court's definition of ghost-foreign agent ("a virtual node corresponding to a foreign agent that can make a mobile node aware of the corresponding foreign agent's presence in a communication network proximate to the predicted future location of the mobile node") because it is a virtual node implemented as a software entity executing on a remote fixed host or mobile support router (MSR) that includes a foreign agent and communicates and pre-connects with local host resources. *See* Liu patent at 6:53-66, 8:7-16, & Fig. 6. The full mobility data network architecture of the Liu patent makes use of a predictive mobility management function to predict the most likely destination of a mobile user (*see id.* at 6:35-50), and the MF-Agent is assigned to a location near the predicted future location of the mobile node. *Id.* at 6:53-66, 8:7-16 & Fig. 6.

249. The Liu paper further discloses an MF-Agent pre-assignment protocol in which the MF-agent "advertises messages to one of the mobile nodes indicating [the] presence of the ghost-foreign agent on behalf of one of the foreign agents," as claimed in Claim 1. In this protocol, a P-agent is a representative of the mobile user and requests the creation and/or assignment of an MF-agent in a location at which the mobile terminal is expected to arrive. *See* Liu paper at 20. This pre-assignment request results in the assignment or creation of an MF-agent at the expected new location. *Id*. The created or assigned MF-agent asks to be registered with the foreign agent and sends an MF_ASSIGNMENT_REPLY message back to the P-agent, which in turn passes the reply message back to the mobile terminal. *Id.* The MF-Agent's Reply message is an advertisement message sent on behalf of the foreign agent indicating the presence of the ghost-foreign agent (M-

Agent) on behalf of one of the foreign agents (shown as "Foreign-Agent" in Figure 7 (annotated above)).

250. Likewise, the Liu patent further discloses an MF-agent pre-assignment protocol in which the MF-agent "advertises messages to one of the mobile nodes indicating [the] presence of the ghost-foreign agent on behalf of one of the foreign agents," as claimed in Claim 1. In this protocol, an M-agent is a representative of the mobile user and requests the creation and/or assignment of an MF-agent in a location at which the mobile terminal is expected to arrive. *See* Liu patent at 7:19-31. This pre-assignment request results in the assignment of an MF-agent at the expected location. *Id.* at 7:37-46. The created or assigned MF-agent then registers itself with the foreign agent and sends an MF-assignment reply back to the M-agent that is then sent back to the mobile terminal. *Id.* at 7:51-57. The MF-agent's reply is an advertisement message sent on behalf of the foreign agent (shown as "Foreign Agent 73" in Figure 6 (annotated above)).

251. To the extent Mobility Workx and its expert contend that an "advertisement message" must be unsolicited, *i.e.*, not in response to a request to identify a foreign agent, the Liu paper or the Liu patent in combination with Gwon I renders such an interpretation obvious. Gwon I discloses a Neighbor Discovery process that allows a router acting as a foreign agent to "advertise" its presence in a foreign network via an unsolicited Router Advertisement message. *See* Gwon I at ¶ 51; *see also id.* at ¶¶ 48-59. Gwon I teaches that "routers voluntarily transmit advertisement packets to advertise their presences to mobile nodes passing by." *Id.* at ¶ 58. Gwon I also discloses that a mobility prediction analysis may be used "to trigger pre-hand-off processing of authentication and security measures, to trigger advance handling of other aspects of the hand-off process itself, or to trigger selection of a new network connection to optimize the quality of the mobile node's connection and/or communications." *Id.* at ¶ 57.

252. A person of ordinary skill in the art (POSITA) would have been motivated to modify the Liu paper or Liu patent to allow MF-agent's to indicate their presence to the mobile node using unsolicited advertisement messages instead of identifying themselves in response to a request from the mobile node because this is nothing more than applying a known technique to a known device ready for improvement to yield predictable results.

253. It was well known to a POSITA before the effective filing date of the '417 Patent in July 2003 to allow existing router/agents to broadcast their presence using unsolicited advertisement messages. As noted in Gwon I, such broadcasts facilitate the pre-assignment of a mobile device before it reached the predicted next foreign network, decreasing the time required to complete a handover with a foreign agent at a next network to which the mobile device was travelling. *Id*. at ¶¶ 50-59. It would also have decreased the computational burden on the mobile device by removing the need to request the assignment of a MF-agent, shifting this burden to the MF-agent on a router in the foreign network, or within the P-agent (M-agent) within the coverage area in which the mobile device currently resides.

254. Further, a POSITA would have recognized that the Liu paper and Liu patent were published before the RFC 2461 and Mobile IP version 6 standards (cited in Gwon I), which describe a standardized implementation of the Neighbor Discovery protocol that uses unsolicited Router Advertisement messages. Between the time of the Liu paper and Liu patent were published and filed, respectively, and the priority date of the '417 Patent, the natural progression of the industry led to providing routers/agents with ability to directly broadcast their presence. This functionality was the widely adopted next step in mobile communications in foreign networks. Therefore, combining the known Neighbor Discovery protocol illustrated in Gwon I with the MF-agent pre-assignment protocol of the Liu paper and Liu patent is consistent with the actual

historical evolution of the technology at the time, which resulted in a more efficient and simplistic method to pre-allocate resources.

255. In view of this, the use of the Neighbor Discovery protocol in combination with the Liu paper or Liu patent would have been obvious to one of skill in the art as of the priority date of the ’417 Patent.

256. The Liu paper and Liu patent further discloses that the advertisement messages are sent “when the mobile node is located in a geographical area where the foreign agent is not physically present.” The Court construed the quoted phrase to mean “when the mobile node is located outside of the region covered by the foreign agent.” Both the Liu paper and Liu patent describe the ability to use MF-agents with a predictive mobility management scheme to support service pre-connection and resource pre-arrangement. *See, e.g.*, Liu paper at Abstract; Liu patent at Abstract.

257. Both the Liu paper and Liu patent further disclose that the pre-assignment protocol can take place when the mobile node is located outside of the region covered by the foreign agent. For example, the Liu patent contemplates at least one scenario in which the time needed for the mobile node to reach the new location is relatively long (for example, a mobile terminal moving from New York City to Europe), in which case a POSITA would understand that the mobile node would be outside the coverage area of the foreign agent. *See* Liu patent at 7:58-8:6. Similarly, the Liu paper discusses changing the location of a mobile terminal and providing dynamical service connections in a system consisting of several Mobile Support Routers (MSRs) serving different geographical areas. *See* Liu paper at 15-16. In such a distributed system, a POSITA would understand that the MSRs would be located in different coverage areas.

[‘417, 1(f)] a ghost-mobile node that creates replica IP messages on behalf of a mobile node, the ghost-mobile node handling signaling required to allocate resources and initiate mobility

on behalf of the mobile node, the ghost-mobile node triggering signals based on a predicted physical location of such mobile node or distance with relation to the at least one foreign agent.

258. The Liu paper and Liu patent each disclose "a ghost-mobile node that creates replica IP messages on behalf of a mobile node, the ghost-mobile node handling signaling required to allocate resources and initiate mobility on behalf of the mobile node, the ghost-mobile node triggering signals based on a predicted physical location of such mobile node or distance with relation to the at least one foreign agent." The Court construed the phrase "a ghost-mobile node that creates replica IP messages on behalf of a mobile node" to mean "a ghost-mobile node that copies IP messages on behalf of a mobile node."

259. Under the Court's construction, the Liu paper discloses "a ghost-mobile node that creates replica IP messages on behalf of a mobile node" because it discloses that a request to create or assign an MF-agent at a predicted location is initiated by the mobile terminal and sent to the P-agent. *See* Liu paper at 17. The M-agent then replicates the request by creating a newly addressed request and sending it to the remote MF-agent manager at the predicted location.

> An MF-agent pre-assignment process involves the exchange of following 2 messages between the mobile terminal, its P-agent and the remote MDP-agent.
>
> 1. MF_ASSIGNMENT_REQ:
>
> The mobile terminal sends an MF_ASSIGNMENT_REQ to its P-agent or active P-agent in the local network with the address of the new location. The P-agent registers the request and forwards it to the remote MDP-agent.

Id. at 20.

260. A POSITA would have understood that, when the Liu paper discloses forwarding a request to a remote location on a different network it is creating a replica IP message on behalf of a mobile node because the forwarding process results in a copying of the original message

request. The initial request sent from the mobile terminal to the P-agent would be addressed to the P-agent, where the P-agent would then copy the message of the request and add a new address directing the request to the foreign network. *Id.* This newly addressed registration request would then elicit a response from the appropriate MF-agent (via the MDP-agent) to facilitate pre-registration of network resources. *See id.* In this way, similar to what is described in the preferred embodiment of the '417 Patent, the P-agent is a ghost mobile node that replicates a registration request (*i.e.*, an IP message) sent on behalf of the mobile node.

261. The copied registration request is an IP message because the mobile terminal, MSR, and fixed servers communicate through a protocol that uses Mobile IP at layer 3. *See* Liu paper at 17 & Figs. 12, 13.

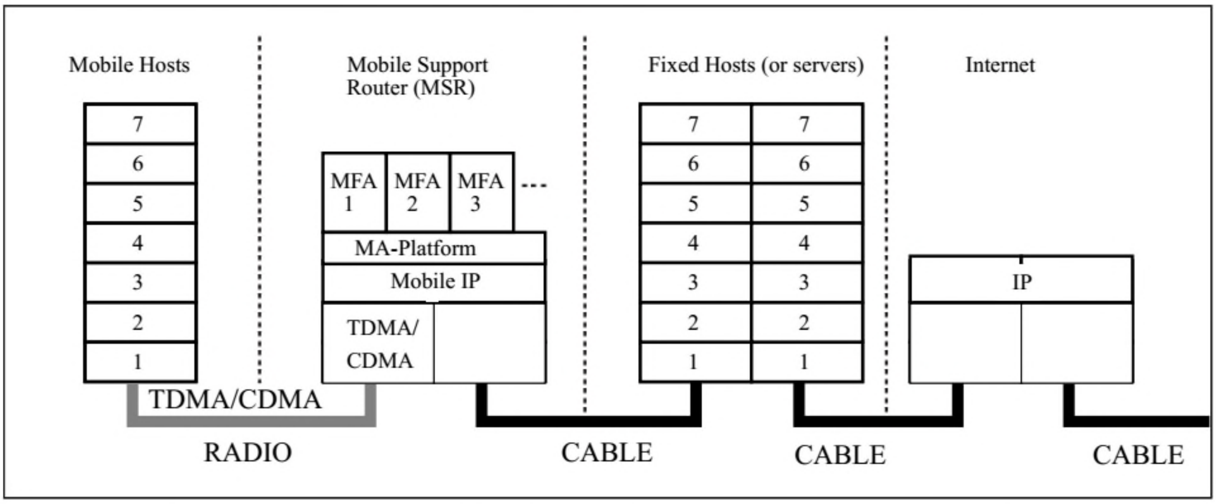


FIGURE 13. An example of the Mobile Floating Agent on the MSR Protocol Architecture.

262. Similarly, under the Court's construction, the Liu patent discloses "a ghost-mobile node that creates replica IP messages on behalf of a mobile node" because it discloses that a request to create or assign an MF-agent at a predicted location is initiated by the mobile terminal and sent to the M-agent. *See* Liu patent at 7:22-38. The M-agent then replicates the request by creating a newly addressed request and sending it to the remote MF-agent manager at the predicted location.

> The M-agent 50 is a representative of the user 21 in the network and is responsible in part for creating, deleting and managing the MF-agents on behalf of mobile users. An M-agent 50 requests creation or assignment of MF-agents 52. As shown in FIG. 7 a mobile terminal 55 sends an MF-agent assignment request to its M-agent 50, in the local network, with an address of a new location it is travelling to (701). The new location may be one that has been explicitly provided by the user 21, or it may be one predicted by the PMM functions 46. The assignment request is a request to establish (i.e., alternatively create or pre-assign) an MF-agent 52 at the location that the mobile terminal 55 will be travelling to and thus have any necessary services and data ready for the mobile terminal, when it arrives at the new location. The M-agent 50 then registers the request and forwards the request 65 to the remote MF-agent manager at the new location (702).

Id.

263. A POSITA would have understood that, when the Liu patent discloses forwarding a request to a remote location on a different network, it is creating a replica IP message on behalf of a mobile node because the forwarding process results in a copying of the original message request. The initial request sent from the mobile terminal to the M-agent would be addressed to the M-agent, where the M-agent would then copy the message of the request and add new address directing the request to the foreign network. *Id.* This newly addressed registration request would then elicit a response from the appropriate MF-agent to facilitate pre-registration of network resources. In this way, the M-agent is a ghost mobile node that replicates a registration request (*i.e.*, an IP message) sent on behalf of the mobile terminal.

264. The copied registration request is an IP message because the mobile terminal, MSR, and servers communicate through a protocol that uses Mobile IP at layer 3. *See id.* at 7:15-17 & Fig. 21.

265. The Liu paper also discloses "the ghost-mobile node handling signaling required to allocate resources and initiate mobility on behalf of the mobile node." Specifically, the P-agent "is a representative of the user in a network" and an "MF-agent can be assigned by a P-agent to a

remote location (node) in the network to perform services, such as pre-connection and resources pre-arrangement on behalf of the P-agent." *See* Liu paper at 16, 18 & Fig. 6.

266. The Liu patent also discloses "the ghost-mobile node handling signaling required to allocate resources and initiate mobility on behalf of the mobile node." Specifically, P-agent performs pre-assignment signaling "to send data or service information from the service area of the home fixed host or router to the MF-agent at each of the remote fixed hosts or routers" on behalf of the mobile node. *See* Liu patent at 2:29-33. The P-agent pre-assignment signaling allows for "services and/or data [to] be pre-connected/pre-arranged at the mobile user's destination." *Id*. at 2:33-35 & Fig. 5.

267. The Liu paper further discloses the "ghost-mobile node triggering signals based on a predicted physical location of such mobile node or distance with relation to the at least one foreign agent" because the P-agent sends the pre-assignment signaling based on the use of Predictive mobility Management Functions (PMF), which includes a prediction of the physical location of the mobile terminal and provides service and resource pre-arrangement for the mobile terminal before it reaches its next destination:

> ***P****redictive mobility* ***M****anagement* ***F****unctions* ***(PMF)****.* The PMF consists of two parts: Location Prediction Functions and Mobile-Distributed Floating Agent Assignment functions (FAA), which assigns the agent to different locations according to the location prediction and provides service pre-connection and service/resource mobility. The location prediction can be performed automatically, by a mobile motion prediction algorithm, or manually, for example via a user's calendar.

Liu paper at 16.

268. Likewise, the Liu patent further discloses the "ghost-mobile node triggering signals based on a predicted physical location of such mobile node or distance with relation to the at least one foreign agent" because the M-agent sends the pre-assignment signaling based on the use of

Predictive Mobility Management Functions (PMM), which includes a prediction of the physical location of the mobile terminal:

> The M-agent 50 is a representative of the user 21 in the network and is responsible in part for creating, deleting and managing the MF-agents on behalf of mobile users. An M-agent 50 requests creation or assignment of MF-agents 52. As shown in FIG. 7 a mobile terminal 55 sends an MF-agent assignment request to its M-agent 50, in the local network, with an address of a new location it is travelling to (701). The new location may be one that has been explicitly provided by the user 21, or it may be one predicted by the PMM functions 46. The assignment request is a request to establish (i.e., alternatively create or pre-assign) an MF-agent 52 at the location that the mobile terminal 55 will be travelling to and thus have any necessary services and data ready for the mobile terminal, when it arrives at the new location. The M-agent 50 then registers the request and forwards the request 65 to the remote MF-agent manager at the new location (702).

Liu patent at 7:22-38.

269. The Liu patent discloses that the Predictive Mobility Management scheme triggers service and resource pre-arrangement for the mobile terminal before it reaches its next destination:

> An aggressive mobility management scheme, called predictive mobility management has been developed. A Predictive Mobility Management (PMM), as described previously, is used to predict the future location of a mobile user according to the user's movement history patterns. The combination of the mobile floating agent concepts with the predictive mobility management allow for service and resource pre-arrangement. The data or services are pre-connected and assigned at the new location before the user moves into the new location.

Id. at 19:4-14; *see also id.* at 13:63-16:19.

270. In addition, the Liu paper or the Liu patent in combination with Gwon I renders obvious the "ghost-mobile node triggering signals based on a predicted physical location of such mobile node or distance with relation to the at least one foreign agent."

271. Gwon I discloses a "mobility prediction analysis [that] results in the determination of a threshold value" that is selected to indicate when a mobile node has sufficiently moved relative

to a network node. Gwon I at ¶ 57. The mobility prediction analysis "may be used to trigger pre-hand-off processing of authentication and security measures" or to "trigger selection of a new network connection to optimize the quality of the mobile node's connection and/or communications." *Id*.

272. Gwon I discloses three different methods of mobility prediction, including a deterministic, stochastic, and adaptive approach. *Id.* at ¶ 60. Each approach is "generally sufficient by itself to accurately provide a threshold value to trigger desired actions by the mobile node." *Id*.; *see also* ¶¶ 59-104.

273. A POSITA would have been motivated to substitute Liu's mobility prediction functions with the alternative mobility prediction methods disclosed in Gwon I to trigger signaling since this is substituting one known element for another to obtain predictable results.

274. A POSITA would have understood that any available method of determining an accurate predicted location would have been a suitable and obvious variation.

5. Analysis—Claim 4

['417, 4(a)] The system of claim 1, wherein the at least one ghost-mobile node is a proxy element for the at least one foreign agent and the at least one mobile node,

275. The Liu paper discloses a P-agent as a proxy element between a mobile terminal and foreign agent. *See* the discussion of limitation 1(f) discussing the P-agent acting on behalf of the mobile terminal for registration with the foreign agent. As discussed above, the P-agent initiates pre-registration procedures on behalf of the mobile node to connect with a foreign agent in the foreign network. This prompts a response from the foreign agent containing registration information that is sent back to the P-agent and then forwarded to the mobile device. Therefore, the P-agent is functioning as a proxy for both the mobile node and the foreign agent.

276. Similarly, the Liu patent discloses an M-agent as a proxy element between a mobile terminal and foreign agent. *See* the discussion of limitation 1(f) discussing the M-agent acting on behalf of the mobile terminal for registration with the foreign agent. As discussed above, the M-agent initiates pre-registration procedures on behalf of the mobile node to connect with a foreign agent in the foreign network. This prompts a response from the foreign agent containing registration information that is sent back to the M-agent and then forwarded to the mobile device. Therefore, the M-agent is functioning as a proxy for both the mobile node and the foreign agent.

[‘417, 4(b)] the at least one ghost-mobile node triggering registration based on a distance to a foreign agent by relaying security and shared secrets from a mobile node, and at least one advertisement message from a foreign agent in a vicinity of the ghost-mobile node.

277. In my opinion, the ‘417 Patent fails to provide a written description of a system that triggers registration … by “relaying” shared secrets from a mobile node to another node. That said, the ‘417 Patent discloses a “shared key” in connection with the use the MD5 algorithm for security and authentication using a public key cryptosystem. *See* ‘417 Patent at 9:18-36. As an alternative, the ‘417 Patent also discloses the use of an asymmetric authentication protocol such as 802.1X. *Id.* at 9:48-53.

278. The Liu paper or Liu patent in combination with Gwon I renders this limitation obvious to the extent this limitation is supported by the disclosures referenced above.

279. Gwon I discloses triggering registration using security information and authentication data based on a distance to a foreign agent. For example, in paragraph [0057], Gwon I discloses that a mobility prediction analysis may be used to trigger pre-hand-off processing of authentication and security measures, to trigger advance handling of other aspects of the hand-off process itself, or to trigger selection of a new network connection to optimize the quality of the mobile node’s connection and/or communications. Gwon I at [0057]. In paragraph [0054], Gwon I

incorporates by reference a number of well-known security and authentication measures, including IETF 2402, which (like the '417 Patent) discloses the use of MD5 authentication algorithms and security protocols during registration of the mobile node.

280. Gwon I also discloses a mobility prediction analysis that is based in part on measuring a distance to each foreign agent using triangulation or GPS techniques. *Id.* at [0076], *see also* [0059].

281. The combination of Liu and Gwon I also renders obvious sending at least one advertisement message from a foreign agent in a vicinity of the ghost-mobile node. Liu discloses a registration reply (advertisement message) from a foreign agent when the ghost-mobile node reaches the foreign network that includes the foreign agent. *See* the discussion of element 1(f) above. Gwon I discloses a distance-based triggering mechanism for foreign agent advertisements. *Id.* at [0054]-[0083]. In an embodiment of Gwon I, a mobility prediction analysis triggers the "advance handling of other aspects of the hand-off process itself" based on a distance to a node in the network (i.e. foreign agent). *Id.* at [0057].

282. A POSITA would have found it obvious to combine the pre-registration signaling and foreign agent advertising of Liu, with Gwon I's Neighbor Discovery protocol and triggering mechanism for these processes. Modifying the Liu system to trigger the disclosed registration and advertisements based on a distance to a foreign agent would eliminate the need for a mobile device to use solicitation processing abilities or location prediction methods for registration, thereby increasing the processing speed of the mobile device and decreasing the overall computational complexity of the system.

6. <u>Analysis—Claim 7</u>

['417, 7(a)] A method, in a mobile node, for speeding handover, comprising the steps of:

283. Both the Liu paper and Liu patent disclose a method, in a mobile node, for speeding handover.

284. For example, the Liu paper describes a mobile virtual-distributed system for wireless data access to network services and resources when a mobile terminal moves. In particular, the Liu paper describes how connectivity from a home agent at a current location of the mobile terminal is transitioned to a remote host or router located at a new location in a wireless local area network or a cellular system as the mobile terminal changes location. *See, e.g.*, Liu paper at Abstract, 5-6, 17-20 & Fig. 7.

285. Likewise, the Liu patent describes the use of a mobile floating (MF)-agent protocol in a mobile database system that accommodates the "mobile nature" of mobile users by offering network service and resource mobility. This is accomplished through intelligent service pre-connection, resource pre-allocation, and data-structure pre-arrangement. By deploying MF-Agents to decouple network services (such as user authentication data, registration data, etc.) and resources from the underlying network and moving them to follow their mobile users, the database becomes virtually distributed and aware of the location of the users. *See, e.g.*, Liu patent at Abstract, 1:55-2:2, 5:55-61, 7:14-8:6, 16:44-16:61 & Figs. 6, 19, 21.

['417, 7(b)] updating, in a mobile node, a location in a ghost mobile node;

286. Both the Liu paper and Liu patent disclose updating, in a mobile node, a location in a ghost mobile node, which the Court construed as "updating the ghost mobile node with a location of the mobile node."

287. The Liu paper and Liu patent each disclose a "ghost mobile node" embodied by the P-agent or M-agent, respectively, as discussed above with respect to Claim Element 1(f) above.

288. The Liu paper further discloses that "[t]he mobile terminal sends an MF_ASSIGNMENT_REQ message to its P-agent or acting P-agent in the local network with the

address of the new location. The P-agent registers the request and forwards it to the remote MDP-agent." *See* Liu paper at 20.

289. Likewise, the Liu patent discloses:

> As shown in FIG. 7 a mobile terminal 55 sends an MF-agent assignment request to its M-agent 50, in the local network, with an address of a new location it is travelling to (701). The new location may be one that has been explicitly provided by the user 21, or it may be one predicted by the PMM functions 46. The assignment request is a request to establish (i.e., alternatively create or pre-assign) an MF-agent 52 at the location that the mobile terminal 55 will be travelling to and thus have any necessary services and data ready for the mobile terminal, when it arrives at the new location. The M-agent 50 then registers the request and forwards the request 65 to the remote MF-agent manager at the new location (702).

Liu patent at 7:27-38; *see also id.* at 2:11-34, 3:8-18.

290. The Liu patent further incorporates by reference U.S. Patent Application No. 08/329,608, which issued as U.S. Patent No. 5,572,221 ("Marlevi") on November 5, 1996. Marlevi is thus prior art under at least 35 U.S.C. §§ 102(a), (b), and (e).[22] The Liu patent states that "by using predictive mobility management to predict where the user will be, as described in [Marlevi], the MF-agent pre-connects services, pre-arranges the secondary cache and prefetches data from the home user cache to be placed in the secondary cache." *Id.* at 7:5-11.

291. Relatedly, Marlevi describes using a Mobile Motion Predictor algorithm to predict the next location a mobile terminal will be travelling to, wherein the output of the algorithm is the mobile terminal's future state corresponding to the future serving cell at the next location of the mobile terminal. *See* Marlevi at Fig. 16 & 5:57-6:2, 7:7-16, 7:29-42, 11:36-41, 15:57-65, 16:29-35, 16:29-35, 16:36-37. For example, Marlevi discloses:

[22] I have been informed that, because Marlevi is incorporated by reference by the Liu patent, Marlevi is effectively an extension of the disclosure of the Liu patent with respect to an invalidity analysis.

> Using Applicants' invention, a mobile terminal or the communication network can predict the mobile's itinerary and take appropriate actions before the mobile reaches a new location. Such predictions can also be used for dynamic channel allocation, mobile terminal location, and call handoffs from channel to channel, either intra-cell or inter-cell, inter-layer or intra-layer. The predictions can be inputs to a locating algorithm, which generates a list of candidate communication channels for handover or assignment of a connection

Id. at 5:57-6:2.

292. Thus, both the Liu paper and Liu patent disclose that the ghost mobile node is updated with a location of the mobile node.

['417, 7(c)] determining a distance, in the ghost mobile node in communication with the mobile node, to a closest foreign agent with which the mobile node can complete a handover;

293. Both the Liu paper and Liu patent disclose determining a distance, in the ghost mobile node in communication with the mobile node, to a closest foreign agent with which the mobile node can complete a handover.

294. For example, the Liu paper discloses that the P-agent sends the pre-assignment signaling based on the use of Predictive mobility Management Functions (PMF), which includes a prediction of the physical location of the mobile terminal and provides service and resource pre-arrangement for the mobile terminal before it reaches its next destination:

> ***P****redictive mobility* ***M****anagement* ***F****unctions* ***(PMF)****.* The PMF consists of two parts: Location Prediction Functions and Mobile-Distributed Floating Agent Assignment functions (FAA), which assigns the agent to different locations according to the location prediction and provides service pre-connection and service/resource mobility. The location prediction can be performed automatically, by a mobile motion prediction algorithm, or manually, for example via a user's calendar.

Liu paper at 16.

295. Likewise, the Liu patent discloses that the M-agent sends the pre-assignment signaling based on the use of Predictive Mobility Management Functions (PMM), which includes a prediction of the physical location of the mobile terminal:

> The M-agent 50 is a representative of the user 21 in the network and is responsible in part for creating, deleting and managing the MF-agents on behalf of mobile users. An M-agent 50 requests creation or assignment of MF-agents 52. As shown in FIG. 7 a mobile terminal 55 sends an MF-agent assignment request to its M-agent 50, in the local network, with an address of a new location it is travelling to (701). The new location may be one that has been explicitly provided by the user 21, or it may be one predicted by the PMM functions 46. The assignment request is a request to establish (i.e., alternatively create or pre-assign) an MF-agent 52 at the location that the mobile terminal 55 will be travelling to and thus have any necessary services and data ready for the mobile terminal, when it arrives at the new location. The M-agent 50 then registers the request and forwards the request 65 to the remote MF-agent manager at the new location (702).

Liu patent at 7:22-38.

296. The Liu patent discloses that the Predictive Mobility Management scheme triggers service and resource pre-arrangement for the mobile terminal before it reaches its next destination:

> An aggressive mobility management scheme, called predictive mobility management has been developed. A Predictive Mobility Management (PMM), as described previously, is used to predict the future location of a mobile user according to the user's movement history patterns. The combination of the mobile floating agent concepts with the predictive mobility management allow for service and resource pre-arrangement. The data or services are pre-connected and assigned at the new location before the user moves into the new location.

Id. at 19:4-14; *see also id.* at 13:63-16:19.

297. Furthermore, Marlevi extends the disclosure of the Liu patent by stating, for example:

> Using Applicants' invention, a mobile terminal or the communication network can predict the mobile's itinerary and take appropriate actions before the mobile reaches a new location. Such

> predictions can also be used for dynamic channel allocation, mobile terminal location, and call handoffs from channel to channel, either intra-cell or inter-cell, inter-layer or intra-layer. The predictions can be inputs to a locating algorithm, which generates a list of candidate communication channels for handover or assignment of a connection

Marlevi at 5:57-6:2; *see also id.* at Fig. 16 & 7:7-16, 7:29-42, 11:36-41, 15:29-33, 15:57-65, 16:29-35, 16:36-37.

298. In addition, the Liu paper or the Liu patent in combination with Gwon I renders obvious the "determining a distance, in the ghost mobile node in communication with the mobile node, to a closest foreign agent with which the mobile node can complete a handover."

299. Gwon I discloses a "mobility prediction analysis [that] results in the determination of a threshold value" that is selected to indicate when a mobile node has sufficiently moved relative to a network node. Gwon I at ¶ 57. The mobility prediction analysis "may be used to trigger pre-hand-off processing of authentication and security measures" or to "trigger selection of a new network connection to optimize the quality of the mobile node's connection and/or communications." *Id.*

300. Gwon I discloses three different methods of mobility prediction, including a deterministic, stochastic, and adaptive approach. *Id.* at ¶ 60. Each approach is "generally sufficient by itself to accurately provide a threshold value to trigger desired actions by the mobile node." *Id.*; *see also* ¶¶ 59-104.

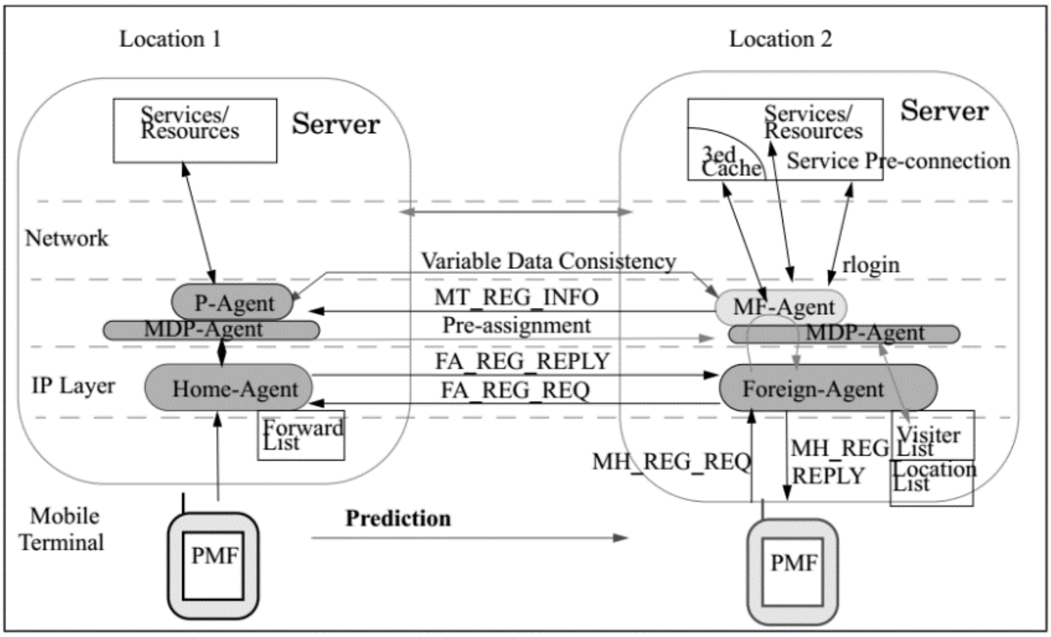
301. A POSITA would have been motivated to substitute the mobility prediction functions in the Liu paper or Liu patent with the alternative mobility prediction methods disclosed in Gwon I to trigger signaling since this is substituting one known element for another to obtain predictable results.

302. A POSITA would have understood that any available method of determining an accurate predicted location would have been a suitable and obvious variation.

['417, 7(d)] submitting on behalf of the mobile node, from the ghost mobile node, a registration to the foreign agent to which the mobile node is going to complete the handover; and

303. Both the Liu paper and Liu patent disclose submitting on behalf of the mobile node, from the ghost mobile node, a registration to the foreign agent to which the mobile node is going to complete the handover.

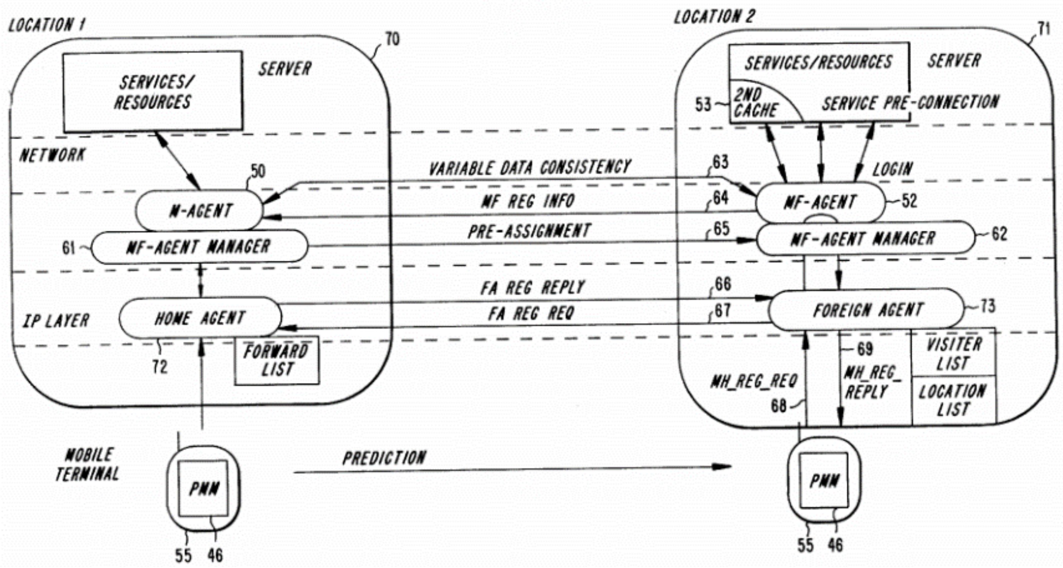
304. For example, the Liu paper discloses that the P-agent (*i.e.*, "ghost mobile node") receives a MF_ASSIGNMENT_REQ message from a mobile terminal (*i.e.*, "mobile node") and forwards the message on behalf of the mobile terminal to the MDP-agent located at the remote host or router (*i.e.*, "foreign agent") to which the mobile terminal will connect. *See* Liu paper at 19-20 & Figs. 7, 15.



Id. at Fig. 7.

305. Likewise, the Liu patent discloses that the M-Agent receives a MF-agent assignment request message from a mobile terminal (*i.e.*, "mobile node") and forwards the message on behalf of the mobile terminal to the MF-agent located at the remote host or router (*i.e.*, "foreign agent") to which the mobile terminal will connect. *See* Liu patent at 3:8-14, 7:19-50 & Fig. 6.

FIG. 6



Id. at Fig. 6.

['417, 7(e)] upon completing the handover, updating a registration in the mobile node.

306. It is my understanding that Plaintiff alleges that in the accused LTE network the target eNB updates a registration in the mobile node by providing uplink allocation and timing advance information to the UE, thereby satisfying this limitation. In my opinion, Plaintiff's allegations do not make sense because *inter alia* in the accused LTE network registration must occur before handover is complete. Nevertheless, if Plaintiff's infringement analysis is proper for this limitation, then both the Liu paper and Liu patent disclose this limitation.

307. For example, the Liu paper discloses:

At the new location, the mobile terminal executes the following registration process:

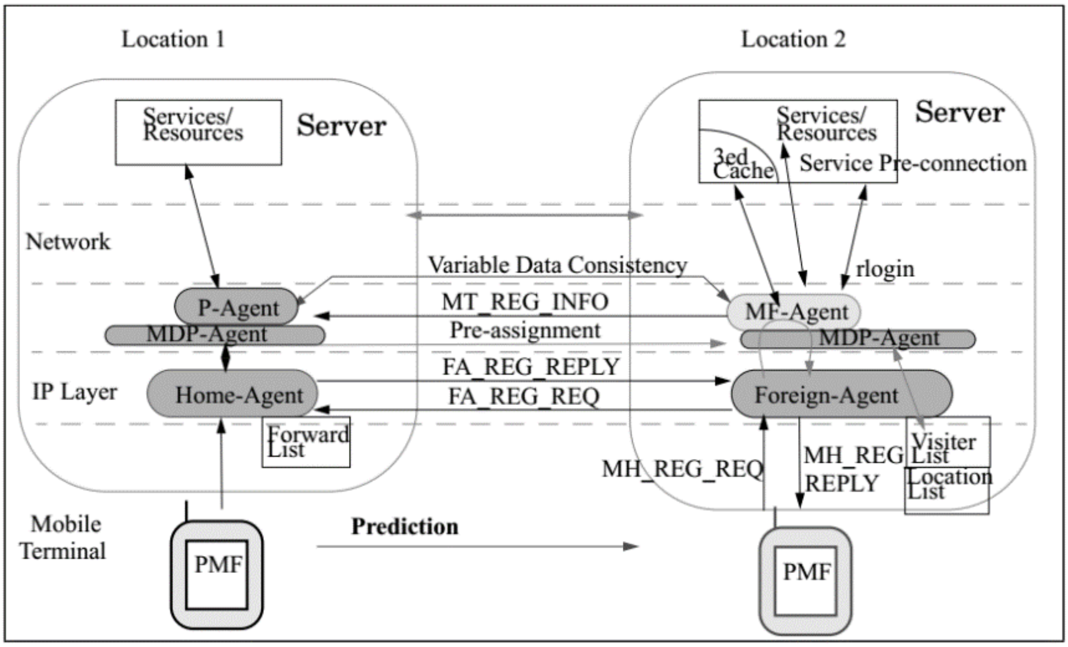
(1) The Mobile Terminal sends a Registration Request to the prospective Foreign Agent to begin the registration process …

(2) The Foreign Agent replies to the request by checking if there is an MF-agent registered for the user. If yes, the Foreign Agent sends a reply message to the mobile terminal to conform the disposition of its request and passes a link to the MF-agent.

...

Upon connected to the mobile terminal, the MF-agent acts as a P-agent (acting P-agent) and sends a MT_REG_INFO message back to the acting P-agent at previous location to de-active it.

Liu paper at 20-21.



Id. at Fig. 7.

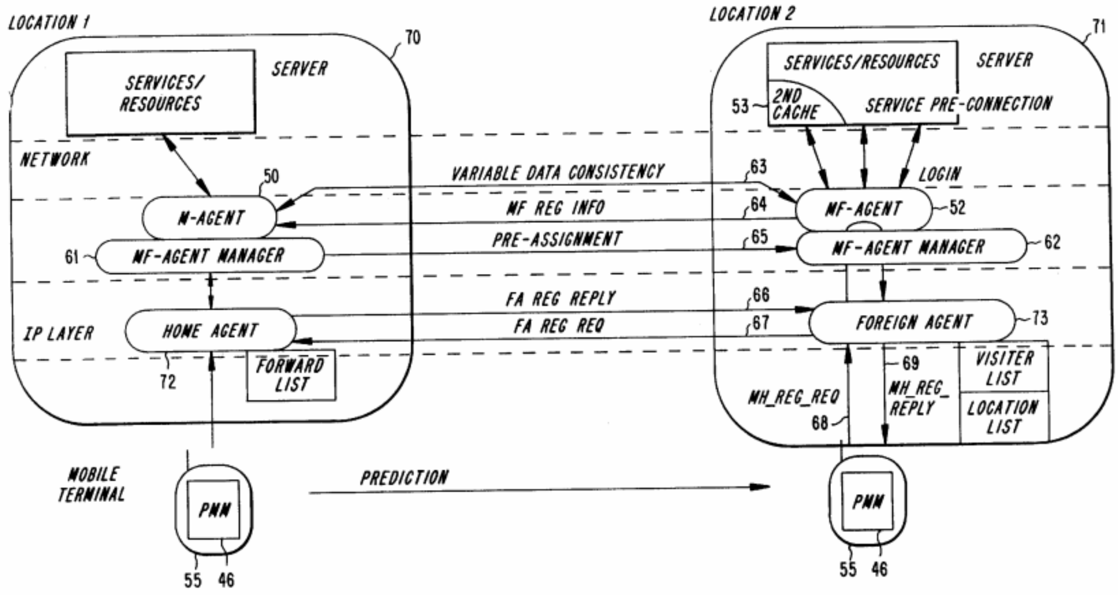
308. Likewise, the Liu patent discloses:

Referring now to FIG. 8, when the mobile terminal 55 reaches the new location, it registers with the MF-agent 52 that has been created or assigned for it there (801). This is accomplished by sending an MF-agent registration request 68 to the F-Agent 73 at the new location to begin the registration process. The F-agent 73 checks to

> see if there is a corresponding MF-agent 52 for the mobile terminal 55 (802). If there is an MF-agent 52, the F-agent 73 confirms this and activates the MF-agent 52 (804). The F-agent 73 then links the mobile terminal 55 to the MF-agent 52 (805). In accordance with another aspect of the invention, the MF-agent now performs as an acting M-agent (AM-agent) for the mobile terminal 55, performing the same function as an M-agent at the new location.

Liu patent at 8:7-20.

FIG. 6



Id. at Fig. 6.

309.

B. Shimizu Anticipates or Renders Obvious the Asserted Claims in View of the 3G UMTS Standard and RFC 2002

1. Shimizu

310. The Shimizu et al. patent application, Pub. No. US 2002/0045450 A1 (“Shimizu”), was published on April 18, 2002, from an application filed on July 9, 2001. It therefore qualifies as prior art under 35 U.S.C. §§ 102(a) and (e) (pre-AIA). Shimizu was not cited or considered during the prosecution of either the ’508 Patent or the ’417 Patent.

311. The Abstract of Shimizu provides:

> In accordance with a handoff method, when a handoff of mobile terminal equipment from a previous foreign agent to a new foreign agent is detected, the mobile terminal equipment is doubly registered with either a home agent or a gateway foreign agent so that the mobile terminal equipment is associated with both the previous foreign agent and the new foreign agent. During the handoff, either the home agent or the gateway foreign agent determines whether or not an IP packet destined for the mobile terminal equipment is of real-time traffic, and then bicasts the IP packet to both the previous foreign agent and the new foreign agent if the IP packet is of real-time traffic, and buffers the IP packet otherwise. When the handoff is completed, the regional registration with either the home agent or the gateway foreign agent is updated so that the mobile terminal equipment is associated only with the new foreign agent. Either the home agent or the gateway foreign agent then transfers IP packets of non-real-time traffic buffered therein to the new foreign agent.

Shimizu at Abstract.

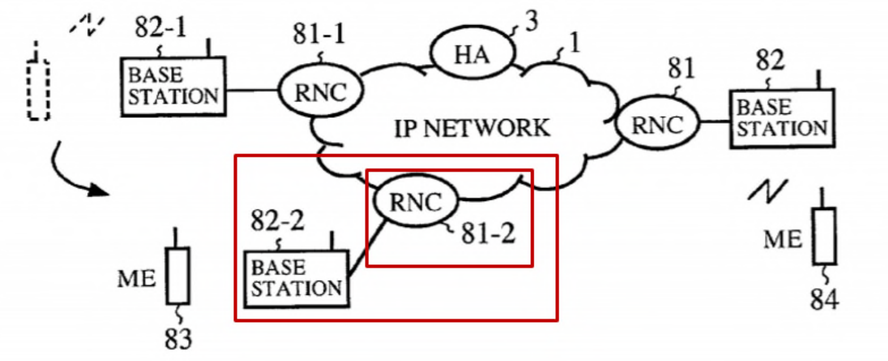
2. <u>Analysis—Claim 1</u>

['417, 1(a)] A system for communicating between a mobile node and a communication network; the network having at least one communications network node that is interconnected using a proxy mobile internet protocol (IP), comprising:

312. Shimizu discloses a system for communicating between a mobile node and a communication network. *See, e.g.*, Shimizu at Fig. 10.

313. For example, the Target RNC 81-2, alone or in combination with the base station 82-2, is a communications network node that is interconnected using a proxy mobile internet protocol (IP). *See, e.g.*, *id.* at ¶ 95 & Figs. 10 (annotated below), 11 & 14.

FIG.10

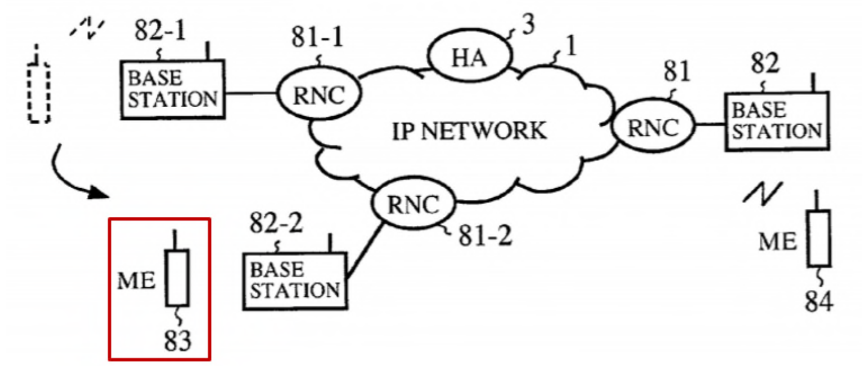


314. Shimizu provides network services and resource distribution to a mobile device as it moves by employing a proxy entity—RNC 81-1 alone or in combination with the base station 82-1—to interconnect the mobile device with the target RNC 81-2 via base station 82-2 to the network using Mobile IP (a mobile internet protocol). *See id.* at ¶¶ 97-102 & Figs. 10, 11.

[‘417, 1(b)] at least one mobile node;

315. Shimizu discloses at least one mobile node as mobile terminal ME 83 in Figure 10. *Id.* at ¶ 95 & Fig. 10 (annotated below).

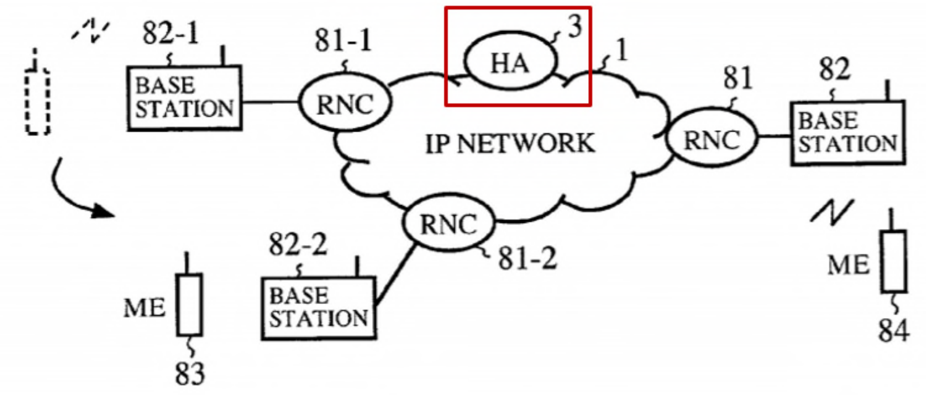
FIG.10



[‘417, 1(c)] at least one home agent;

316. Shimizu discloses a home agent. *Id.* at ¶ 9, 98-99 & Fig. 10 (element 3—HA in the annotated figure below).

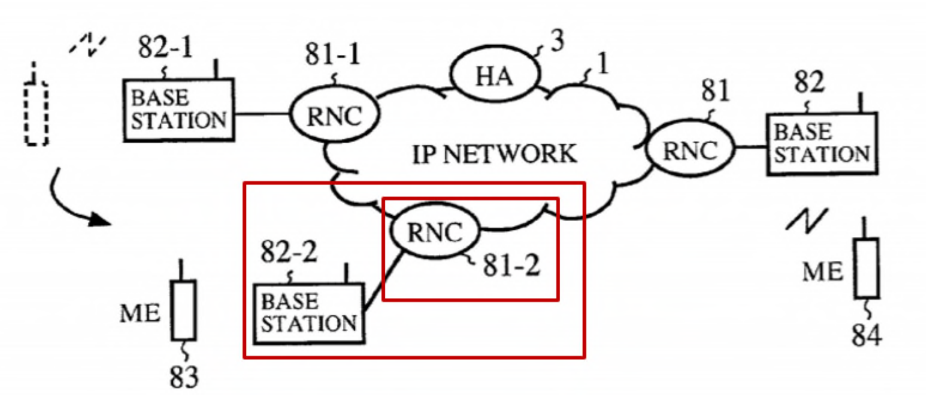
FIG.10



[‘417, 1(d)] at least one foreign agent;

317. The Target RNC 81-2, alone or in combination with the associated base station 82-2, comprises an element is a foreign agent. *See, e.g.*, *id.* at ¶ 95 & Fig. 10 (annotated below) (“…In FIG. 10, reference numerals 81, 81-1, and 81-2 denote radio network control units (RNC) each of which has a function of serving as a foreign agent, and each of which gives and receives an authority to control a cellular phone 83 as a handoff according to an SRNC relocation procedure….”).

FIG.10



The RNC 81-2 is on a visited network relative to the Home Agent 3 and it assists the mobile node in receiving communications using the Mobile IP protocol. *See, e.g.*, *id.* at ¶¶ 4-9, 95 & Fig. 10.

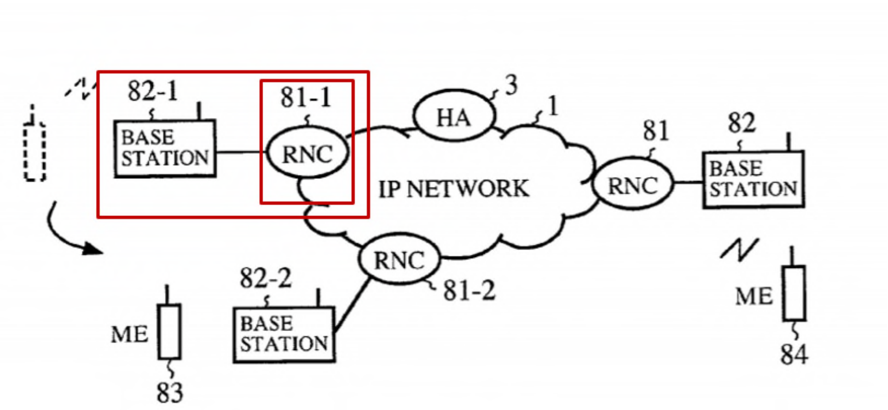
['417, 1(e)] a ghost-foreign agent that advertises messages to one of the mobile nodes indicating presence of the ghost-foreign agent on behalf of one of the foreign agents when the mobile node is located in a geographical area where the foreign agent is not physically present;

318. It is my understanding that the Plaintiff alleges that the Source eNB in the accused LTE network is a ghost-foreign agent that meets this limitation because, among other things, it: (1) sends the mobile node an RRC connection reconfiguration request (after a handover decision has been made), which allegedly includes target cell ID and Physical Cell ID information of the foreign agent, and (2) sends System Information Block Types 4 & 5, which allegedly contain neighboring cell information for the target eNB, to the mobile node. Plaintiff's Infringement Contentions do not explain why these alleged "advertisement messages" are sent to the mobile node "when [it] is located in a geographic area where the foreign agent is not physically present" (which has been construed to mean "when the mobile node is located outside the region covered by the foreign agent"). In my opinion, these RRC and SIB messages are sent to, and received by, the mobile node when it is within the coverage area of the target eNB (the alleged foreign agent).

Nevertheless, if Plaintiff's infringement analysis is proper for this limitation, then Shimizu discloses a ghost-foreign agent meeting this limitation.

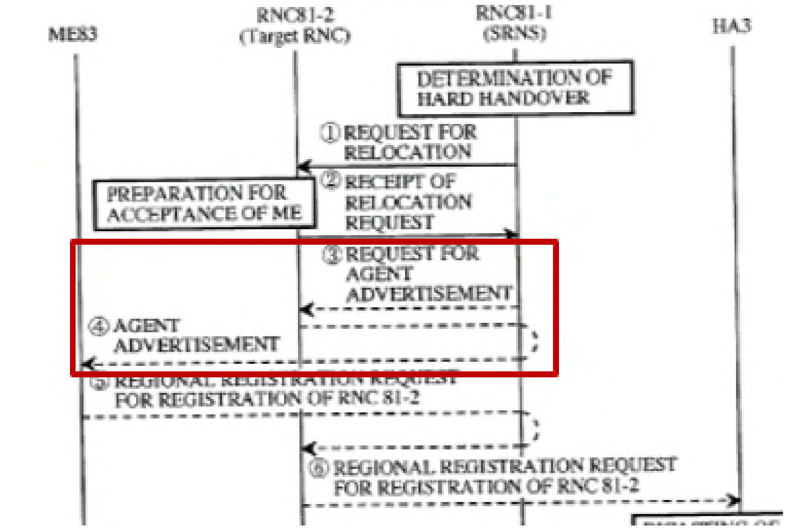
319. The SRNC 81-1, alone or in combination with the associated base station 82-1, comprises an element that serves as a ghost-foreign agent associated with the foreign agent. *See, e.g.*, *id.* at ¶ 95 & Figs. 10 (annotated below), 11; *see also id.* at ¶¶ 97-102.

FIG.10



320. The SRNC 81-1 can announce its presence to the mobile node on behalf of the Target RNC 81-2, for example, through the Request For Agent Advertisement (step 3 in Figure 11) and the Agent Advertisement (step 4 in Figure 11) messages. *See, e.g.*, *id.* at ¶¶ 97-98 & Figs. 11 (steps 3 and 4—annotated below).

FIG.11



321. In addition, if Plaintiff's infringement analysis is proper for this limitation, then Shimizu anticipates this limitation or renders it obvious in view of the third generation ("3G") Universal Mobile Telecommunications Service ("UMTS") standard's serving SRNS relocation procedures (Release 1999), published in or before September 2000, or subsequent prior art releases (including Release 5) as referenced below.

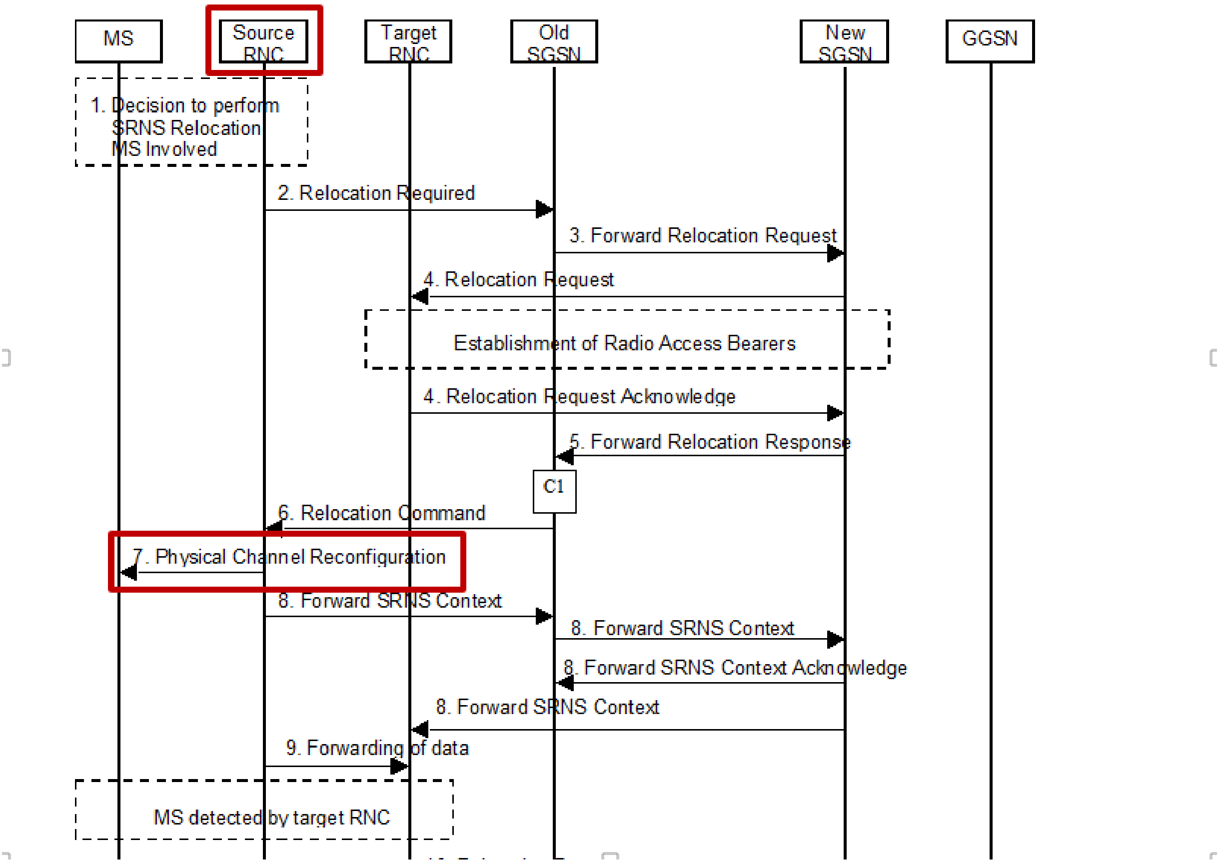
322. In paragraph [0095], Shimizu indicates that it performs handoff according to an SRNC relocation procedure in cellular phone network operating in accordance with the Radio Access Network standard of 3GPP.

323. A POSITA would understand the reference to such a relocation procedure to encompass the RRC protocol described in 3GPP TS 25.331 v3.1.0 (2000-01) and 25.331 V5.1.0 (2002-06), as well as the mobility management functionality, including SRNS (SRNC) relocation procedures, described in 3GPP 23.060 v3.5.0 (2000-10) and 3GPP 23.060 v5.1.0 (2002-03).

324. A POSITA would also consider it obvious to combine Shimizu with the teachings in TS 23.060 and TS 25.331 from the 3GPP standard in view of the discussion of the Radio Access Network standard of 3GPP in paragraph [0095] of Shimizu.

325. By way of example, similar to Plaintiff's infringement contentions, in the network communications system described in Shimizu, alone or in combination with the 3GPP standard publications TS 23.060 and TS 25.331, the Source RNC (ghost foreign agent) sends the mobile node a Physical Channel Reconfiguration (RRC) request (*see* step 7 in Figure 11 of Shimizu and [0100]), which includes, among other things, the identity of the Target RNC, the S-RNTI, and the new Routing Area Identification. *See, e.g.*, 3GPP TS 23.060 v3.5.0 (2000-10) at § 6.9.2.2 (Fig. 42) (annotated portion of this figure and step 7 shown below); *see also* GPP TS 23.060 v.5.1.0 (2002-03) at § 6.9.2.2 (Fig. 42 and step 7).

The Combined Hard Handover and SRNS Relocation procedure for the PS domain is illustrated in figure 42. The sequence is valid for both intra SGSN SRNS relocation and inter SGSN SRNS relocation.



7) Upon reception of the Relocation Command message from the PS domain, the source RNC shall start the data-forwarding timer. When the relocation preparation procedure is terminated successfully and the source SRNC is ready, then the source SRNC shall trigger the execution of relocation of SRNS by sending to the MS the RRC message provided in the Target RNC to source RNC transparent container, e.g., a Physical Channel Reconfiguration (UE Information Elements, CN Information Elements) message. UE Information Elements include among others new SRNC identity and S-RNTI. CN Information Elements contain among others Location Area Identification and Routeing Area Identification.
Before the RRC message is sent (e.g. Physical Channel Reconfiguration) uplink and downlink data transfer in the source SRNC shall be suspended for RABs which requires loss-less relocation.

326. In addition, similar to Plaintiff's Infringement Contentions, in the network communications system described in Shimizu, alone or in combination with 3GPP TS 23.060 and TS 25.331, the Source RNC, alone or in combination with the Node Bs (base stations) that it serves in its Routing Area 1 (RA1) in the SRNS Relocation procedures described in 3GPP TS 23.060 (Release 1999 or subsequent releases, including Release 5), is (are) a ghost foreign-agent.

327. For example, the Source RNC sends System Information Blocks (SIBs 11 & 12) to the UE that contain a list of neighboring cells for the UE to monitor. *See, e.g.*, 3GPP TS 25.331 v3.1.0 (2000-01), §§ 8.1.13, 8.4 (including subsections 8.4.1.6-8.4.1.9), 9.3.1.4-9.3.1.6, 9.3.2.6; 3GPP TS 25.331 v.5.1.0 (2002-06) at §§ 8.1.1.6.11-8.1.1.6.12, 8.4, 8.4.1.6-8.4.1.9, 8.6.7.3, 10.3.7.

328. By way of example, TS 25.331, Section 8.4 provides in relevant part:

8.4 Measurement procedures

The UE measurements are grouped into 6 different categories, according to what the UE should measure.

The different types of measurements are:

- **Intra-frequency measurements**: measurements on downlink physical channels at the same frequency as the active set. Detailed description is found in subclause 14.1.
- **Inter-frequency measurements**: measurements on downlink physical channels at frequencies that differ from the frequency of the active set.
- **Inter-system measurements**: measurements on downlink physical channels belonging to another radio access system than UTRAN, e.g. PDC or GSM.
- **Traffic volume measurements**: measurements on uplink traffic volume. Detailed description is found in subclause 14.2.
- **Quality measurements**: Measurements of quality parameters, e.g. downlink transport block error rate.
- **Internal measurements**: Measurements of UE transmission power and UE received signal level. Detailed description is found in subclause 14.3.

The same type of measurements may be used as input to different functions in UTRAN. However, the UE shall support a number of measurements running in parallel. The UE shall also support that each measurement is controlled and reported independently of every other measurement.

Cells that the UE is monitoring (e.g. for handover measurements) are grouped in the UE into two different categories:

1. Cells, which belong to the **active set.** User information is sent from all these cells and they are simultaneously demodulated and coherently combined. In FDD, these cells are involved in soft handover. In TDD the active set always comprises of one cell only.
2. Cells, which are not included in the active set, but are monitored according to a neighbour list assigned by the UTRAN belong to the **monitored set.**

UTRAN may start a measurement in the UE by transmitting a MEASUREMENT CONTROL message. This message includes the following measurement control information:

All these measurement parameters depend on the measurement type and are described in more detail in chapter 14.

When the reporting criteria are fulfilled, i.e. a specified event occurred or the time since last report indicated for periodical reporting has elapsed, the UE shall send a MEASUREMENT REPORT message to UTRAN.

In idle mode, the UE shall perform measurements according to the measurement control information included in System Information Block Type 11, which is transmitted on the BCCH.

In CELL_FACH, CELL_PCH or URA_PCH state, the UE shall perform measurements according to the measurement control information included in System Information Block Type 12, which is transmitted on the BCCH. If the UE has not received System Information Block Type 12, it shall perform measurements according to the measurement control information included in System Information Block Type 11, which is transmitted on the BCCH.

329. Sections 8.4.1.6 to 8.4.1.9 of TS 25.331 each indicate that the list of neighboring cells is provided in the (1) "intra-frequency cell info" IE (information element) in "System Information Block 12" (or "System Information Block 11") and (2) the "inter-frequency cell info" IE (information element) in "System Information Block 12" (or "System Information Block 11"). *See* 3GPP TS 25.331 v3.1.0 (2000-01) at §§ 8.4.1.6-8.4.1.9; 3GPP TS 25.331 v.5.1.0 (2002-06) at §§ 8.1.1.6.11-8.1.1.6.12, 8.4, 8.4.1.6-8.4.1.9, 8.6.7.3, 10.3.7.

330. I provide a more detailed discussion below concerning the invalidity of the Asserted Claims in view of the 3G UMTS standard, which I incorporate here by reference.

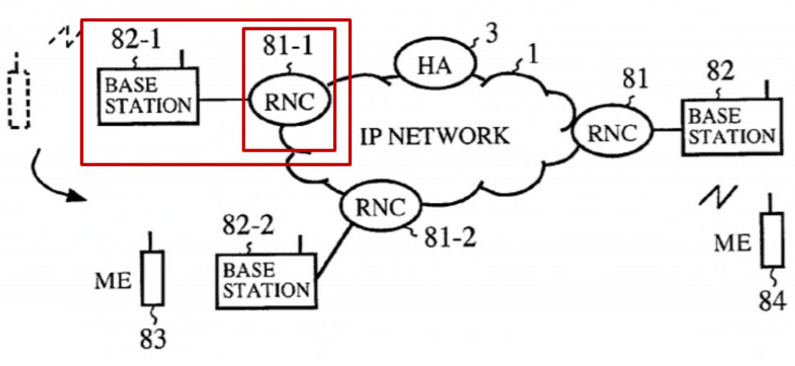
['417, 1(f)] a ghost-mobile node that creates replica IP messages on behalf of a mobile node, the ghost-mobile node handling signaling required to allocate resources and initiate mobility on behalf of the mobile node, the ghost-mobile node triggering signals based on a predicted physical location of such mobile node or distance with relation to the at least one foreign agent.

331. Plaintiff's Infringement Contentions allege that a Handover Request is the replica IP message created by the ghost-mobile node (alleged to be the Source eNB) and that such Handover Request instructs the Target eNB to allocate resources to the mobile node and initiates the handover process on its behalf, but these contentions fail to explain how the Source eNB is capable of registering with a foreign agent and allocating resources for the mobile node before the it arrives in the physical area covered by the foreign agent. In my opinion, the Source eNB cannot register with a foreign agent and allocate resources for the mobile node before the mobile node

arrives in the physical area covered by the foreign agent. Furthermore, it is my understanding that Plaintiff points to certain "UE network/security capabilities" information elements in the HANDOVER REQUEST sent by the Source eNB that are allegedly the same information elements that the UE sends to the network in an ATTACH REQUEST as constituting "cop[ying] IP messages on behalf of a mobile node," per the Court's claim construction. In my opinion, this mapping cannot be correct at least because (i) the original ATTACH REQUEST is not an IP message and (ii) having just one overlapping information element—which I do not agree is demonstrated in Plaintiff's Infringement Contentions—does not constitute "copying" or "replicating" an IP message.

332. Nevertheless, if this infringement analysis is proper for this limitation, then Shimizu discloses a ghost-mobile node agent meeting this limitation. For example, the SRNC 81-1, alone or in combination with the associated base station 82-1, comprises an element that serves as a ghost mobile node. *See, e.g.*, Shimizu at ¶ 95 & Fig. 10 (annotated below).

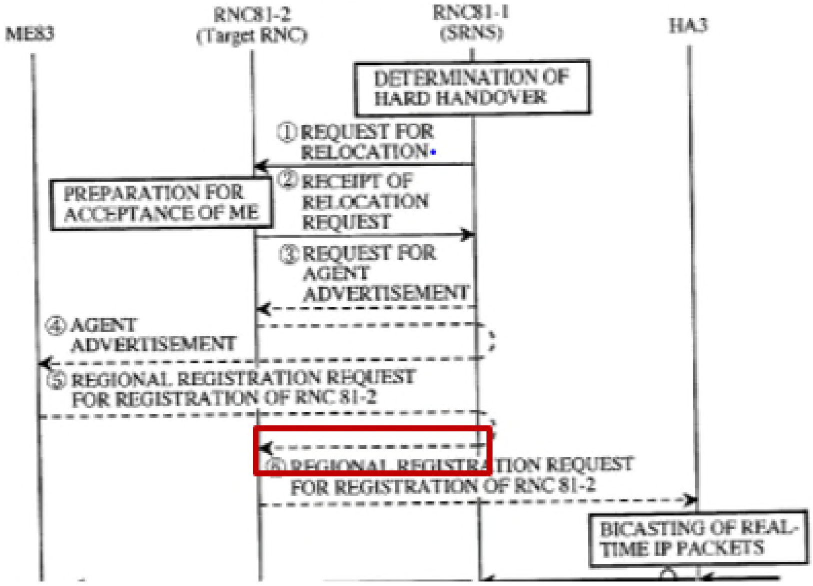
FIG.10



333. The SRNC 81-1 creates replica IP messages on behalf of the ME in step 5 of Figure 11 when it receives an IP Regional Registration Request message from the ME 83 and redirects the message to the target RNC 81-2. *See, e.g.*, *id.* at ¶ 98 & Fig. 11 (step 5 annotated below). The

redirected message is copy of the original message from the mobile node with a new address (namely, the address of the target RNC 81-2 rather the address of the source RNC 81-1). The dashed line in step 5 indicates that that the message is part of the Mobile IP procedure and therefore constitutes in IP registration message.

FIG.11



334. As described in the Mobile IP specification (RFC 2002) referenced in paragraph [0004] of Shimizu, a POSITA reading Shimizu would understand that the Registration Request is an IP message. *See, e.g.*, IETF RFC 2002 at § 3 (Registration).

335. Furthermore, the SRNC 81-1 sends a Request For Relocation Request message 1 that instructs the Target RNC 81-2 to allocate resources to the ME and initiates the handover process. *See, e.g.*, Shimizu at ¶¶ 97-98 & Fig. 11 (step 1), [0097], [0098].

336. The SRNC triggers the Request For Relocation after detecting a start of handover. *See, e.g.*, *id.* at ¶ 97.

337. Plaintiff's Infringement Contentions further allege that the mobile node reports measurements of neighboring cell signals back to the network, which are used to predict when the mobile node will leave its current cell and enter a neighboring cell. Plaintiff explicitly points to Events A3 and A4 in the Measurement Reports. Plaintiff's Infringement Contentions fail to explain how the triggering of signals is based on "a predicted physical location" of the mobile node, as opposed to being based on measuring actual signal strengths for various cells at specified times. In my opinion, the Source eNB does not trigger signals based on a predicted physical location of the mobile node. Nevertheless, if this infringement analysis is proper for this limitation, then Shimizu, alone or in combination with the prior art 3G UMTS standard, discloses a ghost-mobile node agent meeting this limitation.

338. Like the LTE standard's measurement reports identified in Plaintiff's Infringement Contentions, the measurement reports from the mobile node (MS) in the 3G UMTS standard referenced in Shimizu contain events, such as a neighbor signal becoming better than a threshold, or a certain amount better than the signal of the node's current cell. These events indicate to the network that a UE/MS is in a new cell (the alleged "predicted physical location"), and trigger a handover to the new cell. *See, e.g.*, 3GPP TS 23.060 v.3.5.0 (2000-10) at §§ 6.9.2.2.1 (Fig. 39 and steps 13), 6.9.2.2.2 (Fig. 42 and steps 1-3); 3GPP TS 23.060 v.3.5.0 v.5.1.0 (2002-03) at § 6.9.2; 3GPP TS 25.331 v3.1.0 (2000-01) at §§ 10.2.7, 14.1, 14.1.2 (describes a number of intra-frequency reporting events 1A-1F that may lead to a handover to a new cell, including events 1E and 1F, which include a predetermined threshold), 14.2; 3GPP TS 25.331 v.5.1.0 (2002-06) at §§ 10.3.7, 14.1, 14.1.2.

339. By way of example, reporting event 1C in Section 14.1.2.3 provides:

14.1.2.3 Reporting event 1C: A non-active primary CPICH becomes better than an active primary CPICH

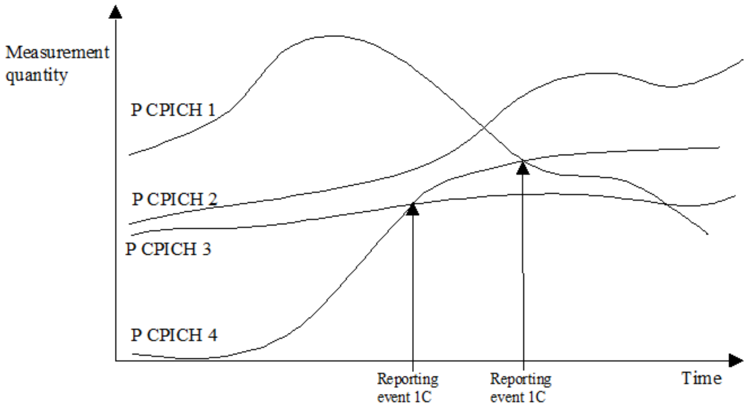


Figure 47: A primary CPICH that is not included in the active set becomes better than a primary CPICH that is in the active set

In this example the cells belonging to primary CPICH 1, 2 and 3 are supposed to be in the active set, but the cell transmitting primary CPICH 4 is not (yet) in the active set.

If a primary CPICH that is not included in the active set becomes better than a primary CPICH that is in the active set, and event 1C has been ordered by UTRAN, this event shall trigger a report to be sent from the UE.

This event may be used for replacing cells in the active set. It is activated if the number of active cells is equal to or greater than a **replacement activation threshold** parameter that UTRAN signals to the UE in the MEASUREMENT CONTROL message. This parameter indicates the minimum number of cells required in the active set for measurement reports triggered by event 1C to be transmitted.

340. I provide a more detailed discussion below concerning the invalidity of the Asserted Claims in view of the 3G UMTS standard, which I incorporate here by reference.

341. Therefore, to the extent this limitation is met in the LTE network, it is also met by the network described in Shimizu alone or in combination with the 3G UMTS standard.

3. <u>Analysis—Claim 4</u>

['417, 4(a)] The system of claim 1, wherein the at least one ghost-mobile node is a proxy element for the at least one foreign agent and the at least one mobile node,

342. The at least one ghost-mobile node (source RNC 81-1) is a proxy element for the at least one foreign agent and the at least one mobile node.

343. For example, the SRNC acts a proxy for the ME because it transmits the Mobile IP registration request message to the Target RNC 81-2 for subsequent transmission to the home agent HA 3. *See, e.g.*, Shimizu at ¶ 98. In addition, the SRNC acts as a proxy for the Target RNC

by redirecting an agent advertisement message 4 to the mobile node and by sending a Request For Reconstruction Of Radio Physical Channel message. *See, e.g.*, *id.* at ¶¶ 98-100 & Fig. 11 (steps 7 and 11).

344. In addition, to the extent this limitation is satisfied in the accused LTE network because the part of the HO command comes from the target eNB and is transparently forwarded to the UE by the source eNB, then this limitation is met in the UMTS Serving SRNS relocation procedures by Relocation Command message (step 6 in Section 6.9.2.2.1 and step 6 in Section 6.9.2.2.2) because the Source RNC (ghost-mobile node) is responsive to instructions transparently forwarded by the SGSN or New SGSN from the Target RNC (foreign agent) to the Source RNC (ghost foreign agent). *See, e.g.*, 3GPP TS 23.060 v3.5.0 and v.5.1.0 at §§ 6.9.2.2.1 (Fig. 39 and steps 4 - 6), 6.9.2.2.2 (Fig. 42 and steps 4-6).

345. In addition, to the extent this limitation is met by the Source eNB acting as a proxy for the UE by setting up a new X2 interface towards the Target eNB, then the Source RNC sets up a new Iur interface towards the Target RNC (foreign agent). *See, e.g.*, 3GPP TS 23.060 v3.5.0 and v5.1.0 at §§ 6.9.2.2.1 (Fig. 39 and step 7 & 8), 6.9.2.2.2 (Fig. 42 and step 9).

346. I provide a more detailed discussion below concerning the invalidity of the Asserted Claims in view of the 3G UMTS standard, which I incorporate here by reference.

['417, 4(b)] the at least one ghost-mobile node triggering registration based on a distance to a foreign agent by relaying security and shared secrets from a mobile node, and at least one advertisement message from a foreign agent in a vicinity of the ghost-mobile node.

347. In my opinion, the '417 Patent fails to provide a written description of a system that "triggers registration … by 'relaying' shared secrets from a mobile node" to another node. That said, the '417 Patent discloses a "shared key" in connection with the use the MD5 algorithm for security and authentication using a public key cryptosystem. *See* '417 Patent at 9:18-36. As an

alternative, the ’417 Patent also discloses the use of an asymmetric authentication protocol such as 802.1X. *Id.* at 9:48-53.

348. To the extent these disclosures support this limitation, Shimizu alone or in combination with the 3G UMTS standard and/or RFC 2002 also discloses this limitation. *See supra* the citations for limitation [1G] above. In addition, the registration request messages in steps 5 and 6 of Figure 11 contain the same information that ME would send to the network upon initial registration to the network using a registration request message sent directly to a home agent. *See, e.g.*, Shimizu at ¶ 98 & Fig. 11 (step 5 and 6); *see also* RFC 2002 at § 3 (Registration).

349. The registration message in Mobile IP (RFC 2002) relays “security and shared secrets” from a mobile node to the extent this limitation is supported by the ‘417 Patent specification. *See* RFC 2002 at §§ 3.2, 3.3, 3.5.1-3.5.4. In particular, Mobile IP registration requests necessarily include an Extensions field, and all Extensions fields include the Security Parameter Index (SPI). *Id.* at § 3.3. The SPI within any of the authentication Extensions defines the security context which is used to compute the Authenticator value and which must be used by the receiver to check that value. In particular, the SPI selects the authentication algorithm and mode (Section 5.1) and secret (a shared key, or appropriate public/private key pair) used in computing the Authenticator. RFC 2002 at § 3.5.1.

350. Furthermore, to the extent the Accused Network meets this limitation because the LocationInfo information element is used to transfer location information available to the UE to the eNB as alleged in the Plaintiff’s Infringement Contentions, then this limitation is also met in Shimizu because the 3GPP system upon which Shimizu is based also transfers location information from the UE to the Source RNC. *See, e.g.*, 3GPP TS 23.060 v.3.5.0 and V5.1.0 at § 12.7.5:

12.7.5 Location Reporting Procedure

This procedure is used by a 3G-SGSN to request the SRNC to report where the MS is currently located, or to report when the MS moves into or out of a given service area. This procedure relates to location services (LCS) and other services (e.g., CAMEL and emergency calls) in UMTS. The overall LCS procedure is to be described in the LCS stage-2 specification, see 3G TS 23.171.

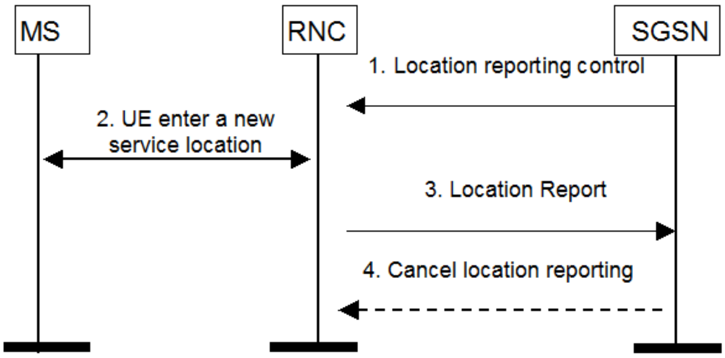


Figure 88: Location Reporting Procedure

351. Finally, Plaintiff's Infringement Contentions addressed the last clause in this limitation ("and at least one advertisement message from a foreign agent in a vicinity of the ghost-mobile node") by alleging that "a foreign agent in the vicinity of the source eNB advertises its Target Cell Identifier (TCI – ECGI/CGI)." The Infringement Contentions lacked such a contention.

352. To the extent that the Source eNB receiving a measurement report containing an identifier for a target cell meets this limitation, then the SRNC's receipt of similar measurement reports containing cell identity information for target cells also meets this limitation. *See, e.g.*, 3GPP TS 25.331 v3.1.0 (2000-01) at §§ 8.1.13, 8.4 (including subsections 8.4.1.1-8.4.1.9), 10.2.7.6 (annotated below), 10.2.7.17, 10.2.7.20.

3G TS 25.331 version 3.1.0 Release 1999 228 3G TS 25.331 V3.1.0 (2000-01)

10.2.7.6 Inter-frequency reporting quantity

Information Element/Group name	Presence	Range	IE type and reference	Semantics description
SFN-SFN observed time difference	M		Boolean	Note 1
Cell Identity	M		Boolean	
UTRA Carrier RSSI	M		Boolean	
Frequency quality estimate	M		Boolean	
CHOICE *mode*				
>FDD				
>>CPICH Ec/N0	M		Boolean	
>>CPICH RSCP	M		Boolean	
>>Pathloss	M		Boolean	
>>CFN-SFN observed time difference	M		Boolean	Note 1
>TDD				
Primary CCPCH RSCP	M		Boolean	

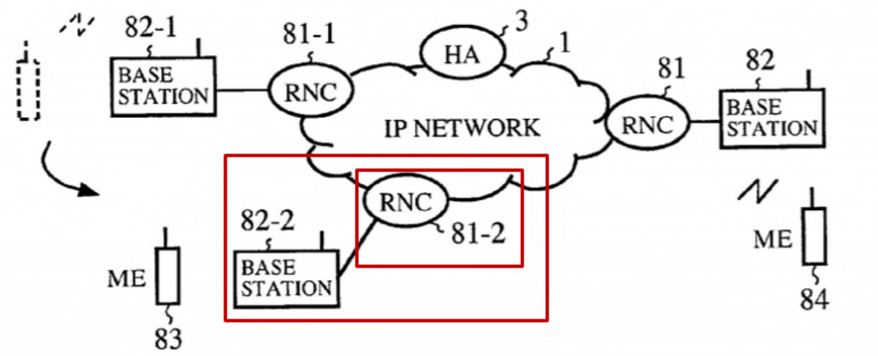
4. Analysis—Claim 7

[‘417, 7(a)] A method, in a mobile node, for speeding handover, comprising the steps of:

353. Shimizu discloses a method, in a mobile node, for speeding handover. *See, e.g.*, Shimizu at Fig. 10.

354. For example, Shimizu provides network services and resource distribution to a mobile device as it moves by employing a proxy entity—RNC 81-1 alone or in combination with the base station 82-1—to interconnect the mobile device with the target RNC 81-2 via base station 82-2 to the network using Mobile IP (a mobile internet protocol). *See id.* at ¶¶ 97-102 & Figs. 10, 11.

FIG.10



['417, 7(b)] updating, in a mobile node, a location in a ghost mobile node;

355. The Court construed this limitation to mean "updating the ghost mobile node with a location of the mobile node."

356. It is my understanding that the Plaintiff alleges that the LocationInfo information element in the accused LTE network defined in 3GPP TS 36.331 meets this limitation because it is allegedly used to transfer location information available to the UE to the source eNB. Plaintiff's Infringement Contentions do not explain how the LocationInfo information element bears any relation to the accused X2 or S1 handover processes. As acknowledged by Plaintiff's own Infringement Contentions, the LocationInfo information element is not relevant to the handover decision, rather it is the signal strength measurements that trigger the accused handover processes. Nevertheless, if Plaintiff's infringement analysis is proper for this limitation, then Shimizu anticipates this limitation or renders it obvious in view of the third generation ("3G") Universal Mobile Telecommunications Service ("UMTS") standard's location reporting procedures (Release 1999), published in or before September 2000, or subsequent prior art releases (including Release 5) as referenced below.

357. In paragraph [0095], Shimizu indicates that it performs handoff according to an SRNC relocation procedure in cellular phone network operating in accordance with the Radio Access Network standard of 3GPP.

358. A POSITA would understand the reference to such a relocation procedure to encompass the RRC protocol described in 3GPP TS 25.331 v3.1.0 (2000-01) and 25.331 V5.1.0 (2002-06), as well as the mobility management functionality, including SRNS (SRNC) relocation procedures, described in 3GPP 23.060 v3.5.0 (2000-10) and 3GPP 23.060 v5.1.0 (2002-03).

359. A POSITA would also consider it obvious to combine Shimizu with the teachings in TS 23.060 and TS 25.331 from the 3GPP standard in view of the discussion of the Radio Access Network standard of 3GPP in paragraph [0095] of Shimizu.

360. Shimizu discloses a "ghost mobile node" as discussed above with respect to Claim Element 1(f) above.

361. Further, similar to Plaintiff's Infringement Contentions, in the network communications system described in Shimizu, alone or in combination with the 3GPP standard publications TS 23.060 and TS 25.331, the serving RNC (*i.e.*, "ghost mobile node") in connection with the SGSN is updated with the location of the mobile station (*i.e.*, "mobile node") when the mobile station moves into or out of a given service area. 3GPP TS 23.060 v.3.5.0 (2000-10) at § 12.7.5.

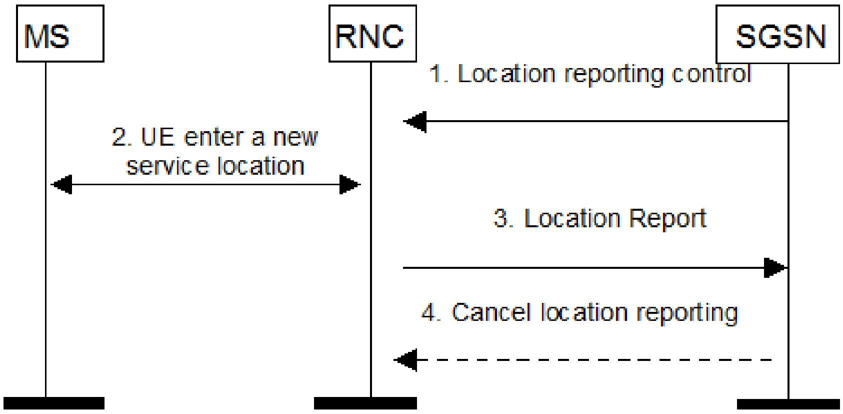


Figure 88: Location Reporting Procedure

362. I provide a more detailed discussion below concerning the invalidity of the Asserted Claims in view of the 3G UMTS standard, which I incorporate here by reference.

['417, 7(c)] determining a distance, in the ghost mobile node in communication with the mobile node, to a closest foreign agent with which the mobile node can complete a handover;

363. Plaintiff's Infringement Contentions allege that the signal strength measurement reports from the mobile node contain events, such as Neighbor signal becoming better than a threshold, or a certain amount better than the signal of the node's current cell, and that these events indicate to the network that a mobile node will be moving into a new cell. Plaintiff explicitly points to Events A3 and A4 in the Measurement Reports. Plaintiff's Infringement Contentions fail to explain how these signal strength measurements constitute "determining a distance … to a closest foreign agent." In my opinion, signal strength measurements do not constitute determining a distance; they are simply measurements of actual signal strengths for various cells at specified times. Nevertheless, if this infringement analysis is proper for this limitation, then Shimizu, alone or in combination with the prior art 3G UMTS standard, discloses this limitation.

364. Like the LTE standard's measurement reports identified in Plaintiff's Infringement Contentions, the measurement reports from the mobile node (MS) in the 3G UMTS standard

referenced in Shimizu contain events, such as a neighbor signal becoming better than a threshold, or a certain amount better than the signal of the node's current cell. These events indicate to the network that a UE/MS is in a new cell (the alleged "predicted physical location"), and trigger a handover to the new cell. *See, e.g.*, 3GPP TS 23.060 v.3.5.0 (2000-10) at §§ 6.9.2.2.1 (Fig. 39 and steps 13), 6.9.2.2.2 (Fig. 42 and steps 1-3); 3GPP TS 23.060 v.3.5.0 v.5.1.0 (2002-03) at § 6.9.2; 3GPP TS 25.331 v3.1.0 (2000-01) at §§ 10.2.7, 14.1, 14.1.2 (describes a number of intra-frequency reporting events 1A-1F that may lead to a handover to a new cell, including events 1E and 1F, which include a predetermined threshold), 14.2; 3GPP TS 25.331 v.5.1.0 (2002-06) at §§ 10.3.7, 14.1, 14.1.2.

365. By way of example, reporting event 1C in Section 14.1.2.3 provides:

14.1.2.3 Reporting event 1C: A non-active primary CPICH becomes better than an active primary CPICH

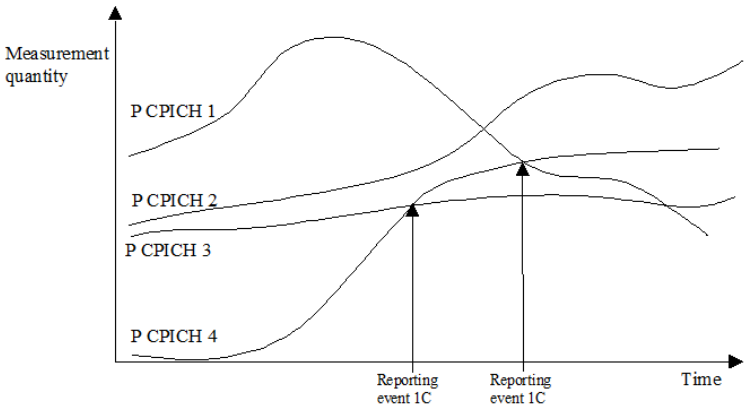


Figure 47: A primary CPICH that is not included in the active set becomes better than a primary CPICH that is in the active set

In this example the cells belonging to primary CPICH 1, 2 and 3 are supposed to be in the active set, but the cell transmitting primary CPICH 4 is not (yet) in the active set.

If a primary CPICH that is not included in the active set becomes better than a primary CPICH that is in the active set, and event 1C has been ordered by UTRAN, this event shall trigger a report to be sent from the UE.

This event may be used for replacing cells in the active set. It is activated if the number of active cells is equal to or greater than a **replacement activation threshold** parameter that UTRAN signals to the UE in the MEASUREMENT CONTROL message. This parameter indicates the minimum number of cells required in the active set for measurement reports triggered by event 1C to be transmitted.

366. It is further my understanding that the Plaintiff alleges that the LocationInfo information element in the accused LTE network defined in 3GPP TS 36.331 meets this limitation because it is allegedly used to transfer location information available to the UE to the source eNB. Plaintiff's Infringement Contentions do not explain how the LocationInfo information element bears any relation to the accused X2 or S1 handover processes. As acknowledged by Plaintiff's own Infringement Contentions, the LocationInfo information element is not relevant to the handover decision, rather it is the signal strength measurements that trigger the accused handover processes. Nevertheless, if this infringement analysis is proper for this limitation, then Shimizu, alone or in combination with the prior art 3G UMTS standard, discloses this limitation for the reasons discussed above in Claim Element 7(b).

367. I provide a more detailed discussion below concerning the invalidity of the Asserted Claims in view of the 3G UMTS standard, which I incorporate here by reference.

368. Therefore, to the extent this limitation is met in the LTE network, it is also met by the network described in Shimizu alone or in combination with the 3G UMTS standard.

['417, 7(d)] submitting on behalf of the mobile node, from the ghost mobile node, a registration to the foreign agent to which the mobile node is going to complete the handover; and

369. Shimizu discloses submitting on behalf of the mobile node, from the ghost mobile node, a registration to the foreign agent to which the mobile node is going to complete the handover.

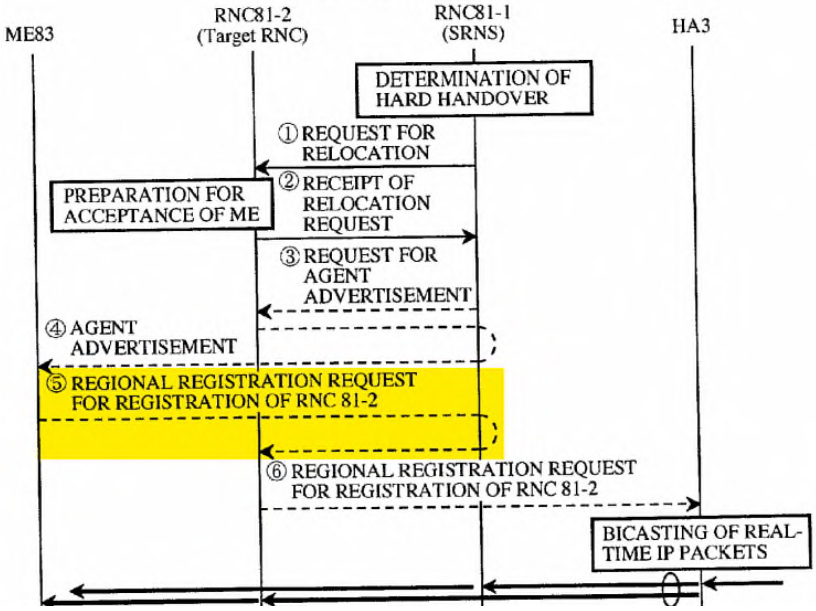
370. For example, Shimizu discloses that during the handover process, a mobile equipment (ME) sends a Regional Registration Request for registration to its serving RNC (*i.e.*, "ghost mobile node"), which in turn forwards that Request to the target RNC on behalf of the ME. Specifically, Shimizu discloses:

Next, a handoff of the ME **83** in the mobile IP network will be explained. Hereafter, assume that the ME **83** is moving from the RNC **81-1** to the RNC **81-2** so that the ME will be accommodated by the RNC **81-2**. At this time, an authority to control the ME **83** is transferred from the base station **82-1**to the base station **82-2** connected to the RNC **81-2** according to an SRNC relocation procedure. FIG. 11 is a sequence diagram for explaining a handover of the ME **83** in the cellular phone network of FIG. 10.

…

The ME **83** receives the agent advertisement and then transmits a mobile IP regional registration message to the RNC **81-2** by way of the RNC **81-1**, and the RNC **81-2** transfers the regional registration message to the HA **3**. In the regional registration, the ME **83** makes a request of the HA **3** to perform simultaneous binding on IP packets of real-time traffic so that they are transferred to both the RNC **81-1** and the RNC **81-2**, and to temporarily buffer IP packets of non-real-time traffic.

FIG.11



Id. at ¶¶ 96-96 & Fig. 11.

['417, 7(e)] upon completing the handover, updating a registration in the mobile node.

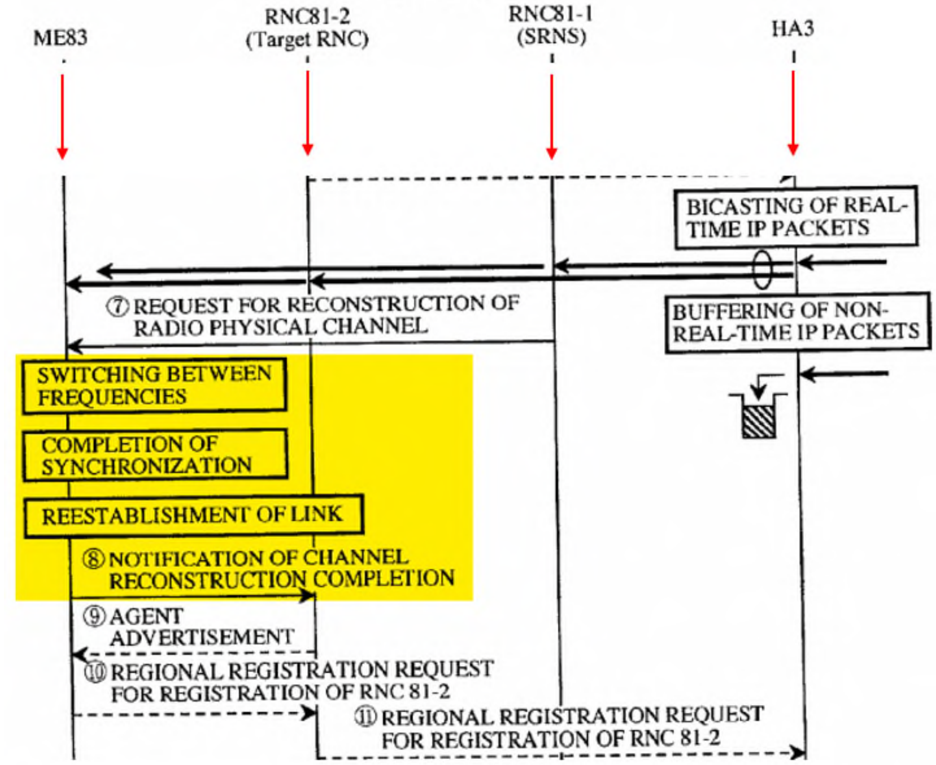
371. It is my understanding that Plaintiff alleges that in the accused LTE network the target eNB updates a registration in the mobile node by providing uplink allocation and timing

advance information to the UE, thereby satisfying this limitation. In my opinion, Plaintiff's allegations do not make sense because *inter alia* in the accused LTE network registration must occur before handover is complete. Nevertheless, if Plaintiff's infringement analysis is proper for this limitation, then Shimizu, alone or in combination with the prior art 3G UMTS standard, discloses this limitation.

372. For example, Shimizu discloses:

> When performing a handover, the RNC **81-1** makes a request of the ME **83**to reconstruct a radio physical channel. When the ME **83** receives the reconstruction request, it changes the frequency and so on, and brings its timing channel in synchronization with a timing channel of other terminal equipment that is the party on the other end of the communication. After that, when the ME **83** reestablishes a radio link with the base station **82-2**, it transmits a message indicating the completion of the reconstruction of the channel to the RNC **81-2** by way of the base station **82-2**. When the RNC **81-2** receives the message, it transmits an agent advertisement to the ME **83** to notify the ME **83** that the handover has been completed. After the handover has been completed, the ME **83** transmits a mobile IP regional registration message including a request to release simultaneous binding and a request for batch-transfer of buffered IP packets to the RNC **81-2**, and the RNC **81-2** then transfers the message to the HA **3**.

FIG.11



Shimizu at ¶ 100 & Fig. 11; *see also id.* at ¶ 114 & Fig. 13.

373. Furthermore, similar to Plaintiff's Infringement Contentions, in the network communications system described in Shimizu, alone or in combination with the 3GPP standard publications TS 23.060 and TS 25.331, the target RNC updates a registration in the mobile station by providing uplink allocation and timing information to the mobile station. For example, in the serving SRNS relation procedure in the 3G UMTS standard:

> After having sent the Relocation Detect message, target SRNC responds to the MS by sending a RNTI Reallocation message. Both messages contain UE information elements and CN information elements. The UE information elements include among others new SRNC identity and S-RNTI. The CN information elements contain among others Location Area Identification and Routeing Area Identification. The procedure shall be coordinated in all Iu signalling connections existing for the MS.
>
> The target SRNC resets and restarts the RLC connections, and exchanges the PDCP sequence numbers (PDCP-SNU, PDCP-SND)

between the target SRNC and the MS. PDCP-SND is the PDCP sequence number for the next expected in-sequence downlink packet to be received in acknowledged mode in the MS per radio bearer, which requires lossless relocation. PDCP-SND confirms all mobile-terminated packets successfully transferred before the start of the relocation procedure.

3GPP TS 23.060 v.3.5.0 (2000-10) at §§ 6.9.2.2.1.

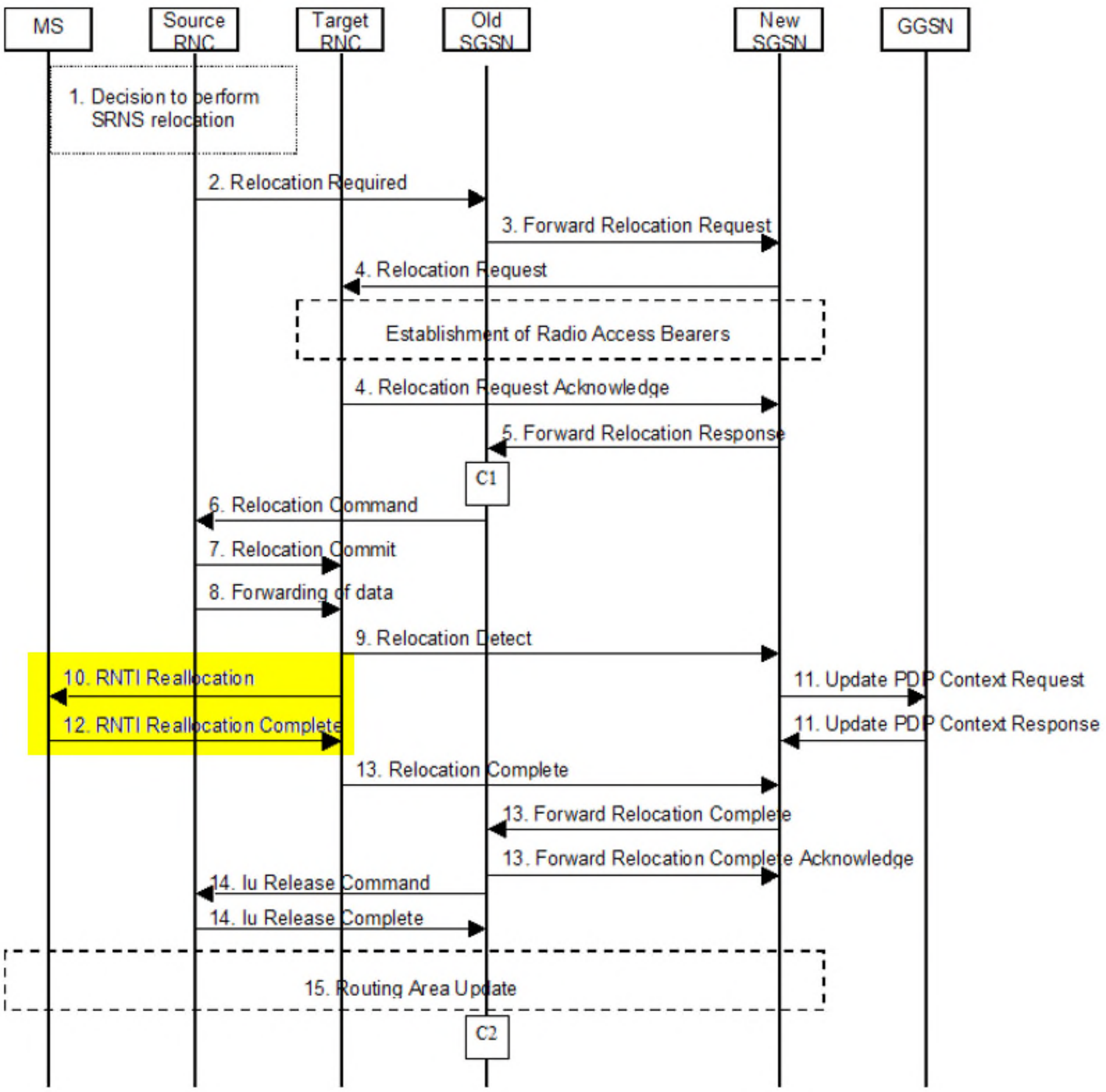


Figure 39: Serving SRNS Relocation Procedure

Id. at Fig. 39.

374. Similarly, with respect to the combined hard handover and SRNS relocation procedure:

> Upon reception of the Relocation Command message from the PS domain, the source RNC shall start the data-forwarding timer. When the relocation preparation procedure is terminated successfully and the source SRNC is ready, then the source SRNC shall trigger the execution of relocation of SRNS by sending to the MS the RRC message provided in the Target RNC to source RNC transparent container, e.g., a Physical Channel Reconfiguration (UE Information Elements, CN Information Elements) message. UE Information Elements include among others new SRNC identity and S-RNTI. CN Information Elements contain among others Location Area Identification and Routeing Area Identification. Before the RRC message is sent (e.g., Physical Channel Reconfiguration) uplink and downlink data transfer in the source SRNC shall be suspended for RABs which requires loss-less relocation.
>
> …
>
> When the MS has reconfigured itself, it sends e.g., a Physical Channel Reconfiguration Complete message to the target SRNC. From now on the exchange of packets with the MS can start.

Id. at § 6.9.2.2.2.

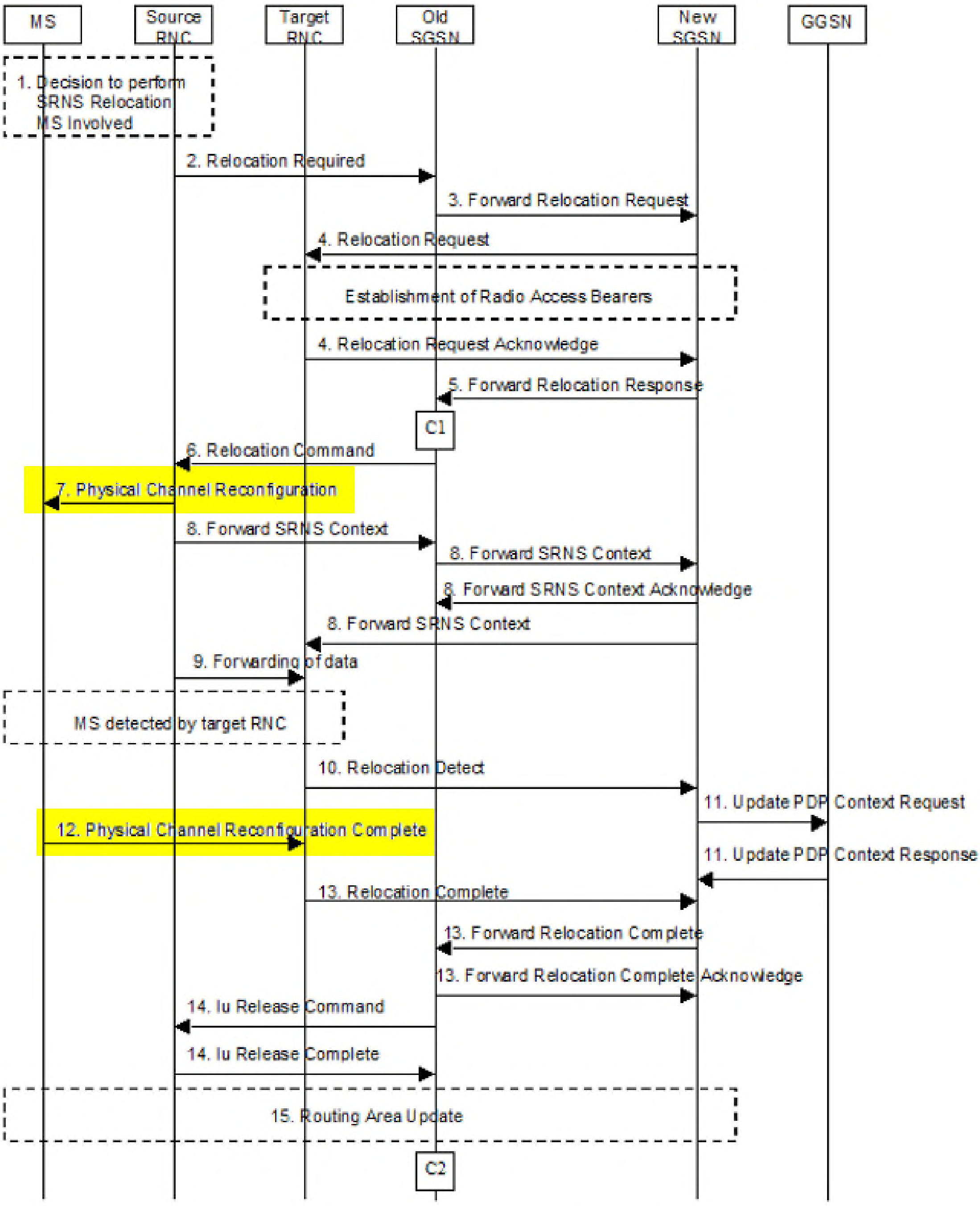


Figure 42: Combined Hard Handover and SRNS Relocation Procedure

Id. at Fig. 42.

375. I provide a more detailed discussion below concerning the invalidity of the Asserted Claims in view of the 3G UMTS standard, which I incorporate here by reference.

376. Therefore, to the extent this limitation is met in the LTE network, it is also met by the network described in Shimizu alone or in combination with the 3G UMTS standard.

C. Under Plaintiff's Interpretation of the Asserted Claims, the 3G UMTS Standard Anticipates or Render Obvious the Asserted Claims

377. As I understand Plaintiff's Infringement Contentions, based on the limited infringement analysis provided therein, it appears that Plaintiff contends, among other things, that: (1) replica IP messages are created in the accused LTE network even though the information sent by the UE upon initial attachment to the network is not sent in an IP message, and (2) the mobile node is outside the coverage area of the target eNB at the time a handover decision is made. While I disagree with these infringement positions, if they are correct then the Asserted Claims are invalid based on the 3G UMTS standard's Hard Handover procedures, alone or in combination with Bahl.

1. <u>The 3G UMTS Standard's Hard Handover and SRNS Relocation Procedures</u>

378. The 3G UMTS standard's hard handover and SRNS relocation procedures (Release 1999 or Release 5) were published in or before June 2002, and other Release 1999 and Release 5 TS and TR documents were published in or before June 2002, and are thus prior art under at least 35 U.S.C. §§ 102(a) and (b). *See, e.g.*, 3GPP TS 25.931 v3.1.0 (2000-09), § 7.11.1.1 (Hard Handover via Iur (Dedicated Channel State)); 3GPP TR 25.931 v5.1.0 Release 5 (2002-06) § 7.11.1.1 (Hard Handover via Iur (DCH State)); 3GPP TS 23.060 v3.5.0 (2000-10), §§ 6.9.2.2.1, 6.9.2.2.2; 3GPP TS 23.060 v5.1.0 (2002-03), §§ 6.9.2.2.1, 6.9.2.2.2. The 3G UMTS standard's hard handover and SRNS relocation procedures (Release 1999 and Release 5) were not cited or considered during the prosecution of the '417 Patent.

379. In Plaintiff's Infringement Contentions, aspects of Verizon's LTE network are accused, involving handovers using the X2 and S1 signaling interfaces. Substantially similar handover procedures using substantially similar interfaces existed in the prior art 3G UMTS

standard. Furthermore, the 3G UMTS standardized network included components that functioned in substantially the same way as the components accused in Verizon's LTE Network. Specifically, the eNodeB component in LTE networks evolved as a combination of the Node B and Radio Network Controller ("RNC") of the 3G UMTS standard. Similarly, the control functionality of the Serving GPRS Support Node ("SGSN") component of the 3G UMTS standard evolved into a control only entity, the Mobility Management Entity ("MME") component in 4G LTE networks, while the SGSN user plane functionality evolved into the Serving Gateway ("S-GW") component in 4G LTE networks. And, finally, the functionality of the Gateway GPRS Support Node ("GGSN") component of the 3G UMTS standard evolved into a Packet Data Network Gateway ("P-GW") component in 4G LTE networks.

2. Bahl—U.S. Patent No. 6,385,454

380. U.S. Patent No. 6,385,454 ("Bahl") issued on May 7, 2002, from an application filed on Oct. 13, 1998. It therefore qualifies as prior art under 35 U.S.C. §§ 102(a) and (b) (pre-AIA). Bahl was not cited or considered during the prosecution of the '417 Patent.

3. Analysis—Claim 1

['417, 1(a)] A system for communicating between a mobile node and a communication network; the network having at least one communications network node that is interconnected using a proxy mobile internet protocol (IP), comprising:

381. The 3G UMTS standard and Bahl each disclose a system for communicating between a mobile node and a communication network. *See, e.g.*, 3GPP TS 25.931 v3.1.0 (2000-09) at § 7.11.1.1 (Hard Handover via Iur (Dedicated Channel State)); 3GPP TR 25.931 v5.1.0 Release 5 (2002-06) at § 7.11.1.1 (Hard Handover via Iur (DCH State)).

382. The Infringement Contentions fail to explain how the accused LTE network is a system for communicating between a mobile node and a communication network that has at least one communications network node interconnected using a proxy mobile internet protocol (IP).

Nevertheless, because of the substantial similarities between the accused LTE network and the network described in the prior art 3G UMTS standard, to the extent this element exists in the accused LTE network, it also exists in the network described in the prior art 3G UMTS standard.

383. Furthermore, as discussed above in Section VIII.E.3, the UMTS standard contemplated the integration of Mobile IP. *See, e.g.*, 3GPP TS 23.060 v.5.1.0 (3/2002) at § 5.7; *see also* 3GPP TS 23.121 v3.6.0 (6/2002) at § 4.10 (Mobile IP for UMTS/GPRS End Users).

384. A POSITA would understand that the resource management scheme in cellular networks disclosed in Bahl could be used in the 3G UMTS standardized network. *See* Bahl at 5:35-37 (in which Bahl states that the invention is independent of the architecture of the underlying wireless cellular communications system).

[‘417, 1(b)] at least one mobile node;

385. The 3G UMTS standard and Bahl each disclose at least one mobile node as a mobile unit, mobile station (MS), or user equipment (UE) (annotated in red in the figure below). *See, e.g.*, 3G TS 25.331 v3.1.0 Release 1999 (2000-01), §§ 8.4 (including subsections); 3GPP TS 25.331 v5.1.0 Release 5 (2002-06) at § 8.4 (including subsections); *see also* 3GPP TS 25.401 v3.2.0 (2000-03), § 6; 3GPP TS 25.401 v5.2.0 Release 5 (2002-03) at § 6; *see also* 3GPP TR 25.931 v3.1.0 (2000-09), § 7.11.1.1 (Hard Handover via Iur (DCH State)); 3GPP TR 25.931 v5.1.0 Release 5 (2002-06) at § 7.11.1.1 (Hard Handover via Iur (DCH State)); Bahl at Abstract, 2:20-36, 3:16-37, 4:7-48, 5:5-14, 5:25-33, 7:11-19, 7:56-8:40, 9:6-41, 11:37-48, 13:53-17:50, 18:5-35, Figs. 1-4, Fig. 7b, Fig. 8, Fig. 11, Fig. 13, Fig. 17, Fig. 18.

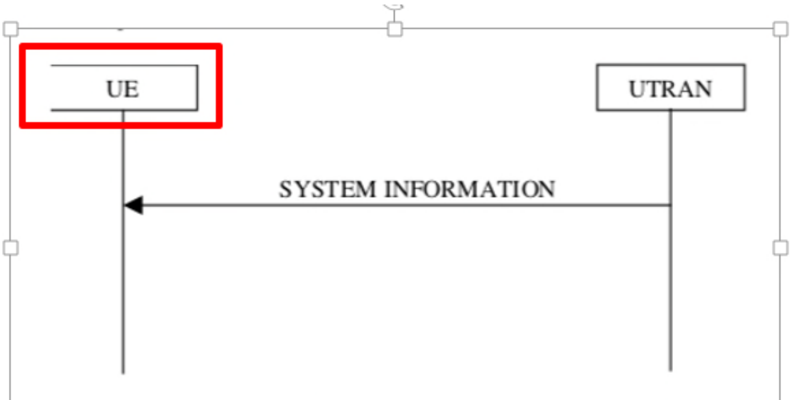


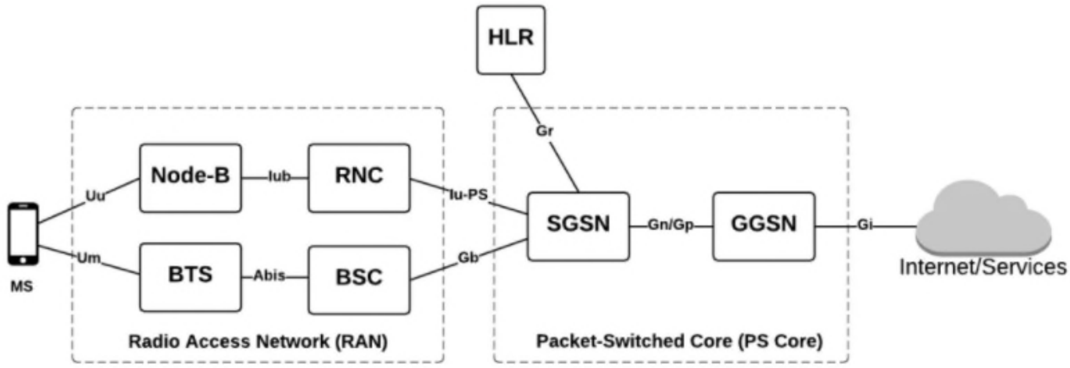
Figure 6: Broadcast of system information

3GPP TS 25.331, Fig. 6.

[‘417, 1(c)] at least one home agent;

386. For this element, Plaintiff’s Infringement Contentions confusingly refer to “a Serving/PDN Gateway contained in the logical block MME / S-GW.” To the extent a Serving Gateway (S-GW) is considered to be a home agent in the accused LTE network, then a SGSN in the 3G UMTS standard is a home agent. To the extent the P-GW is considered to be a home agent in the accused LTE network, then a GGSN in the 3G UMTS standard is a home agent. The UE is assigned an IP address by the GGSN, which is the point of entry towards external networks. The SGSN shown in the figure below forwards traffic to the UE (MS) through one or more RNC and NodeBs.

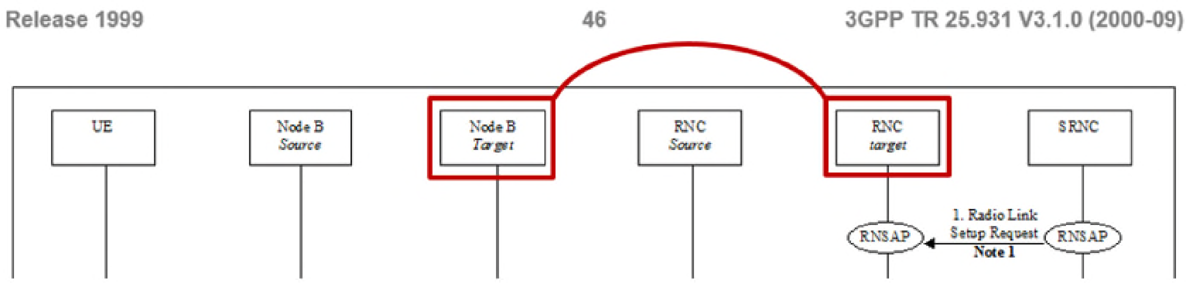
The Basic Core Network Architecture in 3G mobile network is shown in the below figure :



See Core Network Architecture in 3G Mobile Networks, https://orhanergun.net/2016/07/mobile-broadband-ecosystem-ps-core-network-architecture/.

['417, 1(d)] at least one foreign agent;

387. To the extent that one evolved Node B (eNB) is a foreign agent in the accused LTE network for the reasons set forth in the Infringement Contentions, then the Target RNC in combination with the Target Node B it serves is a foreign agent because the 3G system operates in a substantially similar manner to the 4G system. *See, e.g.*, 3GPP TR 25.931 v3.1.0 (2000-09), § 7.11.1.1 (a portion of Fig. 27 at p. 46 is annotated below); *see also* 3GPP TR 25.931 Release 5 v5.1.0 (2002-06), § 7.11.1.1 (Fig. 27); 3GPP 23.060 v3.5.0 Release 1999 (2000-10) § 6.9.2.2.1 (Fig. 39 and related discussion), § 6.9.2.2.2 (Fig. 42 and related discussion); 3GPP 23.060 v5.1.0 Release 5 (2002-03) § 6.9.2.2.1 (Fig. 39 and related discussion) or in the Combined Hard Handover and SRNS Relocation Procedure described in § 6.9.2.2.2 (Fig. 42 and related discussion). The RNC and Node B are referred to as the Radio Network Subsystem ("RNS") in the 3G UMTS standard. The RNS corresponds direct to the eNB in the 4G LTE network.



388. Likewise, to the extent an eNB in the accused LTE network is a foreign agent, then Bahl discloses at least one foreign agent. For example, Bahl describes a next base station and base station controller corresponding to a cell in the trajectory of the mobile device. *See e.g.*, Bahl at 2:20-36, 3:61-4:6, 4:49-60, 5:5-14 & Figs. 1, 8, 9, 12, 14

['417, 1(e)] a ghost-foreign agent that advertises messages to one of the mobile nodes indicating presence of the ghost-foreign agent on behalf of one of the foreign agents when the mobile node is located in a geographical area where the foreign agent is not physically present;

389. It is my understanding that the Plaintiff alleges that the Source eNB in the accused LTE network is a ghost-foreign agent that meets this limitation because, among other things, it: (1) sends the mobile node an RRC connection reconfiguration request (after a handover decision has been made), which allegedly includes target cell ID and Physical Cell ID information of the foreign agent, and (2) sends System Information Block Types 4 & 5, which allegedly contain neighboring cell information for the target eNB, to the mobile node. Plaintiff's Infringement Contentions do not explain why these alleged "advertisement messages" are sent to the mobile node "when [it] is located in a geographic area where the foreign agent is not physically present" (which has been construed to mean "when the mobile node is located outside the region covered by the foreign agent"). In my opinion, these RRC and SIB messages are sent to, and received by, the mobile node when it is within the coverage area of the target eNB (the alleged foreign agent).

390. Nevertheless, if this infringement analysis is proper for this limitation, then the SRNC alone or in combination with the Source Node B it serves in the Hard Handover and SRNS relocation procedures in 25.931 and 23.060 is a ghost-foreign agent. *See, e.g.*, 3GPP TR 25.931 v3.1.0 (2000-09), §§ 7.11.1.1 (Fig. 27 (SRNC alone or in combination with the Source Node B)) at 46; 3GPP TR 25.931 Release 5 v5.1.0 (2002-06), § 7.11.1.1 (Fig. 27 (SRNC alone or in combination with the Source Node B)); 3GPP 23.060 v3.1.0 Release 1999 (2000-10) § 6.9.2.2.1 (Fig. 39 and related discussion) or in the Combined Hard Handover and SRNS Relocation Procedure described in § 6.9.2.2.2 (Fig. 42 and related discussion); 3GPP 23.060 v5.1.0 Release 5 (2002-03) § 6.9.2.2.1 (Fig. 39 and related discussion), 6.9.2.2.2 (Fig. 42 and related discussion).

391. By way of example, similar to Plaintiff's Infringement Contentions, in the network described in 3GPP standard publications, the SRNC (ghost foreign agent) sends an RRC message (Physical Channel Reconfiguration) to the UE, which may include the primary common pilot channel ("CPICH") info associated with the target cell. *See, e.g.*, 3GPP TS 25.331 v3.1.0 (2000-01), § 8.2.6 (including subsections), § 10.1.17; 3G TS 25.331 v5.1.0 Release 5 (2002-06), § 8.2.6 (including subsections), § 10.1.17; 3GPP TR 25.931 v3.1.0 (2000-09), § 7.11.1.1 (Fig. 27, step 7); 3GPP TR 25.931 v5.1.0 (2002-06), § 7.11.1.1 (Fig. 27, step 7).

392. In addition, similar to Plaintiff's Infringement Contentions, in the network described in 3GPP standard publications, the System Information Blocks (SIBs 11 & 12) sent to the UE contain a list of neighboring cells for the UE to monitor. *See, e.g.*, 3GPP TS 25.331 v3.1.0 (2000-01), §§ 8.1.13, 8.4, 9.3.1.4, 9.3.1.5, 9.3.1.6, 9.3.2.6, 10.2.7.2, 10.2.7.13; *see also* 3GPP TS 25.331 v5.1.0 Release 5 (2002-06) at §§ 8.1.13, 8.4 (including §§ 8.4.1.1-8.4.1.9), 10.3.7.13, 10.3.7.33, B.3.1.6-B.3.1.8, B.3.2.6.

393. By way of example, TS 25.331 (Release 1999), Section 8.4 provides in relevant part:

8.4 Measurement procedures

The UE measurements are grouped into 6 different categories, according to what the UE should measure.

The different types of measurements are:

- **Intra-frequency measurements**: measurements on downlink physical channels at the same frequency as the active set. Detailed description is found in subclause 14.1.
- **Inter-frequency measurements**: measurements on downlink physical channels at frequencies that differ from the frequency of the active set.
- **Inter-system measurements**: measurements on downlink physical channels belonging to another radio access system than UTRAN, e.g. PDC or GSM.
- **Traffic volume measurements**: measurements on uplink traffic volume. Detailed description is found in subclause 14.2.
- **Quality measurements**: Measurements of quality parameters, e.g. downlink transport block error rate.
- **Internal measurements**: Measurements of UE transmission power and UE received signal level. Detailed description is found in subclause 14.3.

The same type of measurements may be used as input to different functions in UTRAN. However, the UE shall support a number of measurements running in parallel. The UE shall also support that each measurement is controlled and reported independently of every other measurement.

Cells that the UE is monitoring (e.g. for handover measurements) are grouped in the UE into two different categories:

1. Cells, which belong to the **active set.** User information is sent from all these cells and they are simultaneously demodulated and coherently combined. In FDD, these cells are involved in soft handover. In TDD the active set always comprises of one cell only.
2. Cells, which are not included in the active set, but are monitored according to a neighbour list assigned by the UTRAN belong to the **monitored set.**

UTRAN may start a measurement in the UE by transmitting a MEASUREMENT CONTROL message. This message includes the following measurement control information:

All these measurement parameters depend on the measurement type and are described in more detail in chapter 14.

When the reporting criteria are fulfilled, i.e. a specified event occurred or the time since last report indicated for periodical reporting has elapsed, the UE shall send a MEASUREMENT REPORT message to UTRAN.

In idle mode, the UE shall perform measurements according to the measurement control information included in System Information Block Type 11, which is transmitted on the BCCH.

In CELL_FACH, CELL_PCH or URA_PCH state, the UE shall perform measurements according to the measurement control information included in System Information Block Type 12, which is transmitted on the BCCH. If the UE has not received System Information Block Type 12, it shall perform measurements according to the measurement control information included in System Information Block Type 11, which is transmitted on the BCCH.

394. Sections 8.4.1.6 to 8.4.1.9 of TS 25.331 (Release 1999) each indicate that the list of neighboring cells is provided in the (1) "intra-frequency cell info" IE (information element) in "System Information Block 12" (or "System Information Block 11") and (2) the "inter-frequency

cell info" IE (information element) in "System Information Block 12" (or "System Information Block 11"). *See* 3GPP TS 25.331 v3.1.0 (2000-01), §§ 8.4.1.6-8.4.1.9, 10.2.7.2, 10.2.7.13; *see also* 3GPP TS 25.331 v5.1.0 (2002-06) at §§ 8.4.1.1-8.4.1.9, 10.3.7.2, 10.3.7.13 (reproduced below), 10.3.7.33.

10.3.7.13 Inter-frequency cell info list

Contains the information for the list of measurement objects for an inter-frequency measurement.

Information Element/Group name	Need	Multi	Type and reference	Semantics description
CHOICE *Inter-frequency cell removal*	OP			
>Remove all inter-frequency cells				No data
>Remove some inter-frequency cells				
>>Removed inter-frequency cells	MP	1 .. <maxCellMeas>		
>>>Inter-frequency cell id	MP		Integer(0 .. <maxCellMeas>-1)	
>No inter-frequency cells removed				No data
New inter-frequency cells	OP	1 to <maxCellMeas>		
>Inter-frequency cell id	MD		Integer(0 .. <maxCellMeas>-1)	
>Frequency info	MD		Frequency info 10.3.6.36	Default value is the value of the previous "frequency info" in the list. NOTE: The first occurrence is then MP.
>Cell info	MP		Cell info 10.3.7.2	
Cell for measurement	CV-*BCHopt*	1 to <maxCellMeas>		
>Inter-frequency cell id	MP		Integer(0 .. <maxCellMeas>-1)	

395. Likewise, Bahl discloses a ghost-foreign agent that advertises messages to one of the mobile nodes indicating presence of the ghost-foreign agent on behalf of one of the foreign agents when the mobile node is located in a geographical area where the foreign agent is not physically present. For example, Bahl describes a base station and controller (such as an RNC and NodeB in the 3G UMTS network) that broadcasts on a beacon frequency to mobile devices in its cell each base station and controller's identification and topology information, including a set of

virtual circuit identifier numbers for the base stations and controllers along the mobile's predicted route. *See e.g.*, Bahl at 18:5-19, 18:37-55, Fig. 7B, 12:29-36. The mobile's predicted route includes virtual circuit identifier numbers for base stations and base station controllers along its global predicted route, which are not neighboring cells and are outside the coverage area of the current base station and controller. *Id.*

396. A POSITA would understand that Bahl's invention could be implemented in a 3G UMTS network and would be motivated combine Bahl with cellular networks, including the 3G UMTS network, as suggested in Bahl in its Background of the Invention and Summary of the Invention sections. *See, e.g.*, Bahl at 1:14-4:6.

['417, 1(f)] a ghost-mobile node that creates replica IP messages on behalf of a mobile node, the ghost-mobile node handling signaling required to allocate resources and initiate mobility on behalf of the mobile node, the ghost-mobile node triggering signals based on a predicted physical location of such mobile node or distance with relation to the at least one foreign agent.

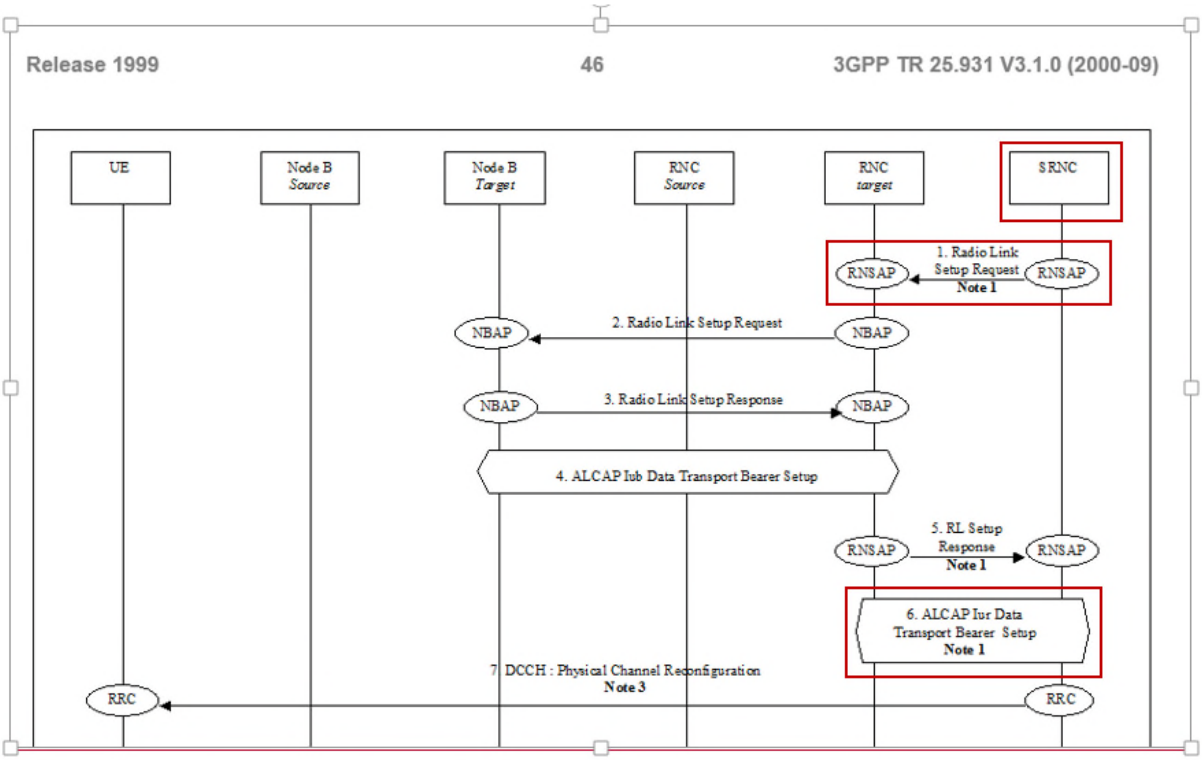
397. Plaintiff's Infringement Contentions allege that a HANDOVER REQUEST in LTE is a replica IP message created by the ghost-mobile node (alleged to be the Source eNB) and that such HANDOVER REQUEST instructs the Target eNB to allocate resources to the mobile node and initiates the handover process on its behalf, but these contentions fail to explain, for example, how the Source eNB is capable of registering with a foreign agent and allocating resources for the mobile node before the mobile node arrives in the physical area covered by the foreign agent. In my opinion, the Source eNB cannot register and allocate resources for the mobile node before the mobile node arrives in the physical area covered by the foreign agent. Furthermore, it is my understanding that Plaintiff points to certain "UE network/security capabilities" information elements in the HANDOVER REQUEST sent by the Source eNB that are allegedly the same information elements that the UE sends to the network in an ATTACH REQUEST as constituting

"cop[ying] IP messages on behalf of a mobile node," per the Court's claim construction. In my opinion, this mapping cannot be correct at least because (i) the original ATTACH REQUEST is not an IP message and (ii) having just one overlapping information element—which I do not agree is demonstrated in Plaintiff's Infringement Contentions—does not constitute "copying" or "replicating" an IP message.

398. Nevertheless, if Plaintiff's infringement analysis is proper for this limitation, then the 3G UMTS standard network discloses a ghost-mobile node meeting this limitation under Plaintiff's reasoning. In addition, as set forth in more detail below, Bahl discloses as system that includes a ghost mobile node that can register and pre-allocate resources for the mobile node before the mobile node arrives in the physical area covered by the foreign agent. Therefore, the combination of the 3G UMTS standard network with Bahl discloses this limitation under a proper interpretation of the Court's claim construction.

399. Focusing first on the 3G UMTS standard network's hard handover procedures, the SRNC alone or in combination with the Source Node B in the hard handover procedure in Section 7.11.1.1 of TR 25.931 is a ghost mobile node because it creates replica IP messages on behalf of a mobile node and is capable of registering with a foreign agent and allocating resources for the mobile node before the mobile node arrives in the physical area covered by the foreign. The ghost mobile node (SRNC) can initiate a registration by transmitting a registration request to the Target RNC such that the Target RNC can then register and allocate resources for the mobile node.

400. For example, the SRNC sends a Radio Link Setup Request message to the Target RNC. *See, e.g.*, 3GPP TR 25.931 v3.1.0 (2000-09), § 7.11.1.1 (relevant portions of Fig. 27 illustrated below); *see also* 3GPP TR 25.931 Release 5 v5.1.0 (2002-06), § 7.11.1.1 (Fig. 27).



401. The Radio Link Setup Request is an IP message because SCTP over IP may be used to carry signaling messages over the Iur interface between the SRNC and the Target RNC. *See* 3GPP TS 25.422 v3.5.0 (2000-12) at § 5.2 (shown below); 3GPP TS 25.422 v5.0.0 (2002-03) at § 5.2:

5.2 Signalling Bearer

This subclause refers to specifications of the Signalling Bearer for the Radio Network Layer protocols. As shown in figure 1, the standard allows operators to choose one out of two protocol to suites for transport of SCCP messages.

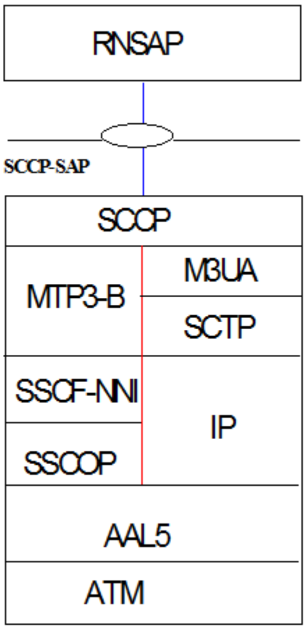


Figure 1: Signalling bearer for RNSAP

402. The Radio Link Setup Request message from the SRNC to the Target RNC includes RB Identity information. *See, e.g.*, 3GPP TS 25.423 v.3.2.0, § 9.1.3.2 (shown below); 3GPP TS 25.423 v.5.1.0, §§ 9.1.3.2, 9.2.3.15.

Release 1999 57 3G TS 25.423 V3.2.0 (2000-06)

>Scheduling Priority Indicator	M				–	
>BLER	M				–	
USCH Information		*0 to <maxnoofUSCHs>*			GLOBAL	reject
>USCH ID	M				–	
>CCTrCH ID	M			UL CCTrCH in which the USCH is mapped	–	
>TrCh Source Statistics Descriptor	M				–	
>Transport Format Set	M			For USCH	–	
>Allocation/Retention Priority	M				–	
>Scheduling Priority Indicator	M				–	
>RB Info		1 to <maxnoofRB>		All Radio Bearers using this USCH	–	
>>RB Identity	M				–	
RL Information		1			YES	reject
>RL ID	M		9.2.1.49		–	
>C-Id	M		9.2.1.6		–	
>Frame Offset	M		9.2.1.30		–	
>Primary CCPCH RSCP	O		9.2.3.5		–	
>Time slot ISCP Info		*0..<maxnoofDLts>*			–	
>>Time slot	M				–	
>>Time slot ISCP	M				–	

403. The same RB Id is sent by the UE to the UTRAN in a physical uplink shared channel ("PUSCH") Capacity Request, which allows the UE to request capacity for one or more uplink shared channels ("USCHs"). *See* 3GPP TS 25.331 v.3.1.0 §§ 8.2.8, 10.1.21 (shown below); 3GPP TS 25.331 v.5.1.0 §§ 8.2.8, 10.2.26, 10.3.7.67. Under Plaintiff's application of the Court's claim construction, the Radio Link Setup Request message is a "copy" of the PUSCH Capacity Request message the UE sends to the network, because these messages contain the "same" information.

3G TS 25.331 version 3.1.0 Release 1999 123 3G TS 25.331 V3.1.0 (2000-01)

10.1.21 PUSCH CAPACITY REQUEST (TDD only)

This message is used by the UE for request of PUSCH resources to the UTRAN.

RLC-SAP: TM

Logical channel: SHCCH

Direction: UE → UTRAN

Information Element	Presence	Multi	IE type and reference	Semantics description
Message Type	M			
UE information elements				
Integrity check info	O			
C-RNTI	M			
Measurement information elements				
Traffic amount information		1 to <RABCount>		Send traffic amount information for each Radio Access Bearer in the message
>RB ID	M			
>RLC buffer payload	M			
>Measured results on RACH	O			

404. In addition to the hard handover procedures in UMTS, the SRNS relocation procedures defined in Section 6.9.2.2 of TS 23.060 also demonstrate this limitation. *See* 3GPP TS 23.060 v.3.1.0 at § 6.9.2.2 (and subsections); 3GPP TS 23.060 v.5.1.0 at § 6.9.2.2 (and subsections).

405. In particular, the new SGSN constitutes a "ghost-mobile node that creates replica IP messages on behalf of a mobile node, the ghost-mobile node handling signaling required to allocate resources and initiate mobility on behalf of the mobile node" under Plaintiff's reasoning. The new SGSN transmits a "Relocation Request" message to the Target RNC such that Target RNC can then register and allocate resources for the mobile node.

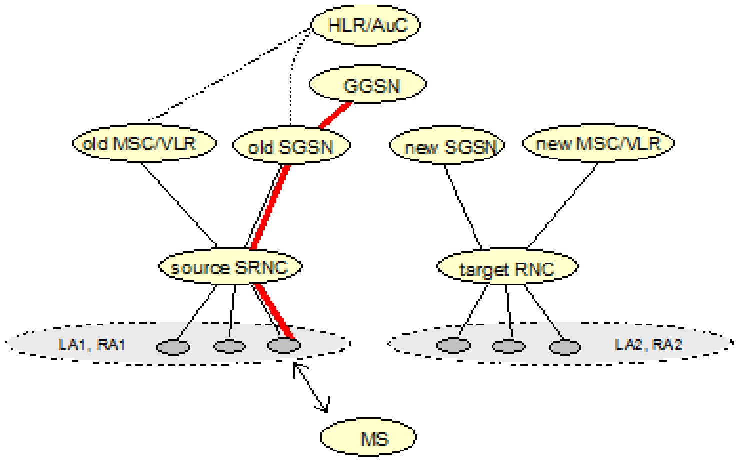


Figure 40: Before Combined Hard Handover and SRNS Relocation and Routeing Area Update

Before the SRNS Relocation and Routeing Area Update the MS is registered in the old SGSN and in the old MSC/VLR. The source RNC is acting as serving RNC.

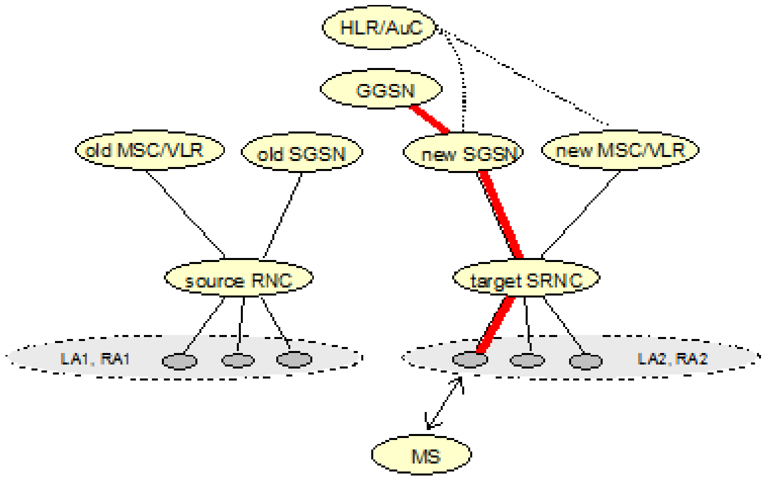


Figure 41: After Combined Hard Handover and SRNS Relocation and Routeing Area Update

After the SRNS relocation and RA update, the MS is registered in the new SGSN and in the new MSC/VLR. The MS is in state PMM-CONNECTED towards the new SGSN and in MM IDLE state towards the new MSC/VLR. The target RNC is acting as serving RNC.

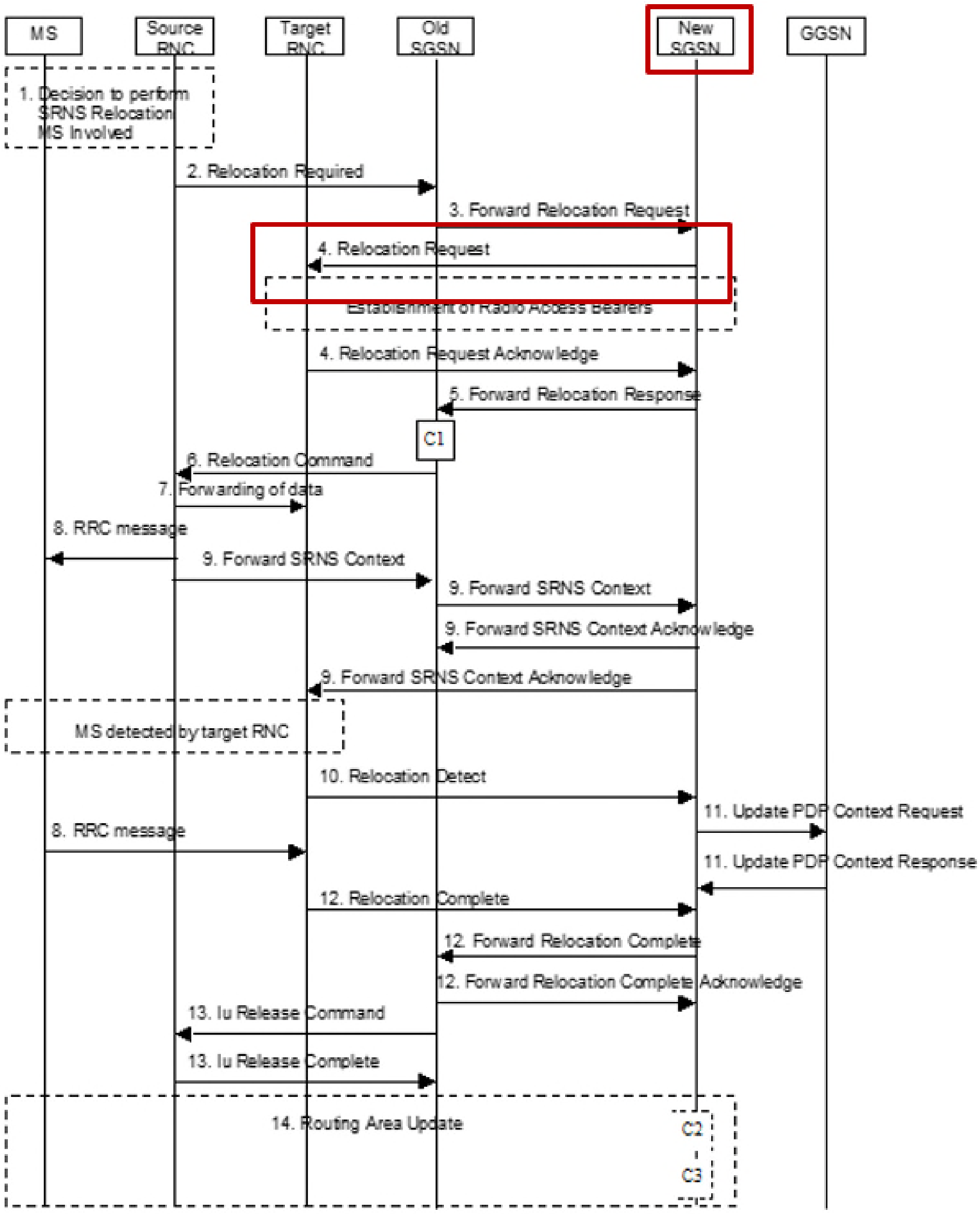


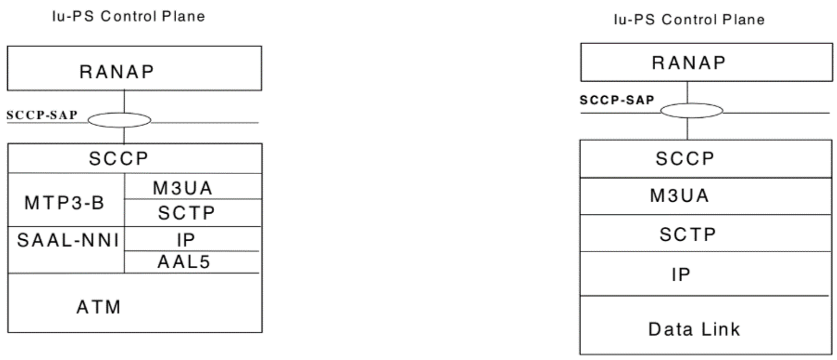
Figure 42: Combined Hard Handover and SRNS Relocation Procedure

406. The "Relocation Request" is an IP message because IP may be used to carry signaling messages over the Iu-PS interface between the new SGSN and Target RNC. *See, e.g.*, 3GPP TS 25.412 Release 5 v5.0.0 (2002-03), §§ 5.3.1 and 5.3.4 (shown below).

5.3 Signalling Bearer for Packet Switched Domain

5.3.1 Protocol Stack for the PS Domain

The protocol stacks for the PS Domain is shown in figure 2. The standard allows operators to choose one out of three standardised protocol suites for transport of SCCP messages.



Protocol stacks for ATM transport options **Protocol stack for IP transport option**

Figure 2: SAP between RANAP and its transport for the Iu –IP domain

Figure 2 shows, for the Iu IP domain, the point at which the service primitives are invoked. A single SAP is defined independently of the signalling bearer. The SAP provides the SCCP primitives. The figure is not intended to constrain the architecture.

5.3.4 IP Transport Option

1. **SCCP** , see subclause 5.3.2.
2. **M3UA**, refers to the SCCP adaptation layer "SS7 MTP3 – User Adaptation Layer " [17] also developed by the Sigtran working group of the IETF.
3. **SCTP**, refers to the Stream Control Transmission Protocol [16] developed by the Sigtran working group of the IETF for the purpose of transporting various signalling protocols over IP networks.
4. **IP**. IPv6 shall be supported according to [25]. IPv4 support [13] is optional.

   Note: This does not preclude the single implementation and use of IPv4.

   Due to the possible transition from IPv4 to IPv6, the IP dual stack support is recommended.

An RNC using IP transport option shall support Diffserv code point marking [26]. The Diffserv code point may be determined from the application parameters.

407. The "Relocation Request" sent by the new SGSN to the Target SGSN contains "Permanent NAS UE Identity, … , Source RNC To Target RNC Transparent Container, RAB To Be Setup." 3GPP TS 23.060 v3.1.0 Release 1999 (2002-10), § 6.9.2.2.2; 3GPP TS 23.060 v5.1.0 Release 5 (2002-03), § 6.9.2.2.2 (*see* excerpt below).

4) The new SGSN sends a Relocation Request message (Permanent NAS UE Identity, Cause, CN Domain Indicator, Source RNC To Target RNC Transparent Container, RAB To Be Setup) to the target RNC. For each RAB requested to be established, RABs To Be Setup shall contain information such as RAB ID, RAB parameters, Transport Layer Address, and Iu Transport Association. The RAB ID information element contains the NSAPI value, and the RAB parameters information element gives the QoS profile. The Transport Layer Address is the SGSN Address for user data, and the Iu Transport Association corresponds to the uplink Tunnel Endpoint Identifier Data.

After all the necessary resources for accepted RABs including the Iu user plane are successfully allocated, the target RNC shall send the Relocation Request Acknowledge message (Target RNC To Source RNC Transparent Container, RABs Setup, RABs Failed To Setup) to the new SGSN. Each RAB to be setup is defined by a Transport Layer Address, which is the target RNC Address for user data, and the Iu Transport Association, which corresponds to the downlink Tunnel Endpoint Identifier for user data. The transparent container contains all radio-related information that the MS needs for the handover, i.e., a complete RRC message (e.g., Physical Channel Reconfiguration in UTRAN case, or Handover From UTRAN, or Handover Command in GERAN Iu mode case) to be sent transparently via CN and source SRNC to the MS. For each RAB to be set up, the target RNC may receive simultaneously downlink user packets both from the source SRNC and from the new SGSN.

408. The Permanent NAS UE Identity consists of the IMSI. *See* 3GPP TS 25.413 v3.2.0 Release 1999 (2000-06); 3GPP TS 25.413 v5.0.0 Release 4 (2001-03) (UTRAN Iu Interface RANAP Signalling).

409. The Source RNC To Target RNC Transparent Container includes a "RRC Container" information element, which is defined as either "RRC initialisation information, source RNC to target RNC" or "RRC initialisation information, source system to target RNC" as defined in TS 25.331. *Id.* at § 9.2.1.18. The information in this "Transparent Container" originates from the Source RNC and is transparently sent to the Target RNC via the SGSN. *See, e.g.*, 3GPP TS 25.331 v5.1.0 Release 5 (2002-06), § 6.14.1.2 (shown below).

6.14.1.2 UE Capability (Iu mode)

The UE capability information element contains all the radio capabilities of the MS (power control, code resource, UE mode, ciphering, PDCP capabilities, etc.) that the RNC has to know in order to handle radio resources for this MS.

The MS sends the UE capability information element to the serving RNC upon RRC connection establishment, and the RNC stores it. This is done before the Attach Request or Routeing Area Update Request message is sent.

NOTE: In Iu mode, only the RNC handles the radio capabilities.

At SRNC relocation the source RNC sends the UE capability transparently through the core network to the target RNC. If the RNC has not received the UE capability information it can request the MS to send the information.

At inter-system change the UE capability is transferred from the MS to the serving RNC on RRC connection establishment before the Routeing Area Update Request message is sent.

Details are provided in 3GPP TS 25.331 and 3GPP TS 25.413.

410. 3GPP TS 25.331 v5.1.0, § 14.12.1 (excerpt shown below) describes the "RRC Information to target RNC" included in the RRC Container.

14.12.1 RRC Information to target RNC

RRC Information to target RNC may either be sent from source RNC or from another RAT. In case of handover to UTRAN, this information originates from another RAT, while in case of SRNC relocation the RRC information originates from the source RNC. In case of SRNC information, the RRC information transferred specifies the

ETSI

3GPP TS 25.331 version 3.5.0 Release 1999 602 ETSI TS 125 331 V3.5.0 (2000-12)

configuration of RRC and the lower layers it controls, e.g., including the radio bearer and transport channel configuration. It is used by the target RNC to initialise RRC and the lower layer protocols to facilitate SRNC relocation in a manner transparent to the UE.

411. Alternatively, the source RNC, alone in combination with the old SGSN, constitutes a "ghost-mobile node that creates replica IP messages on behalf of a mobile node, the ghost-mobile node handling signaling required to allocate resources and initiate mobility on behalf of the mobile node" under Plaintiff's reasoning. The source RNC can initiate a registration by transmitting a registration request ("Relocation Required" message) to the old SGSN, and the old SGSN sends a "Forward Relocation Request" message to the new SGSN such that the new SGSN and target RNC can then register and allocate resources for the mobile node.

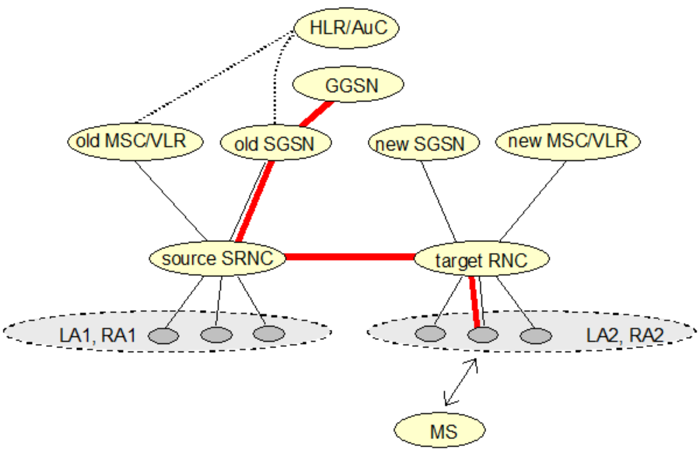


Figure 37: Before SRNS Relocation and Routeing Area Update

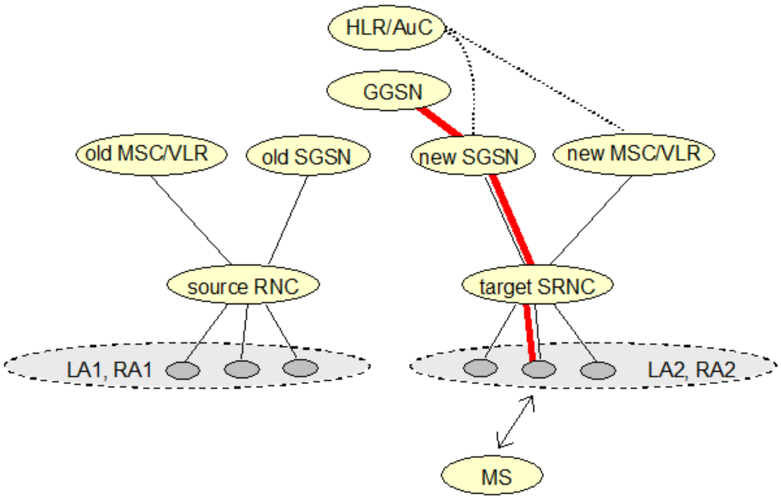


Figure 38: After SRNS Relocation and Routeing Area Update

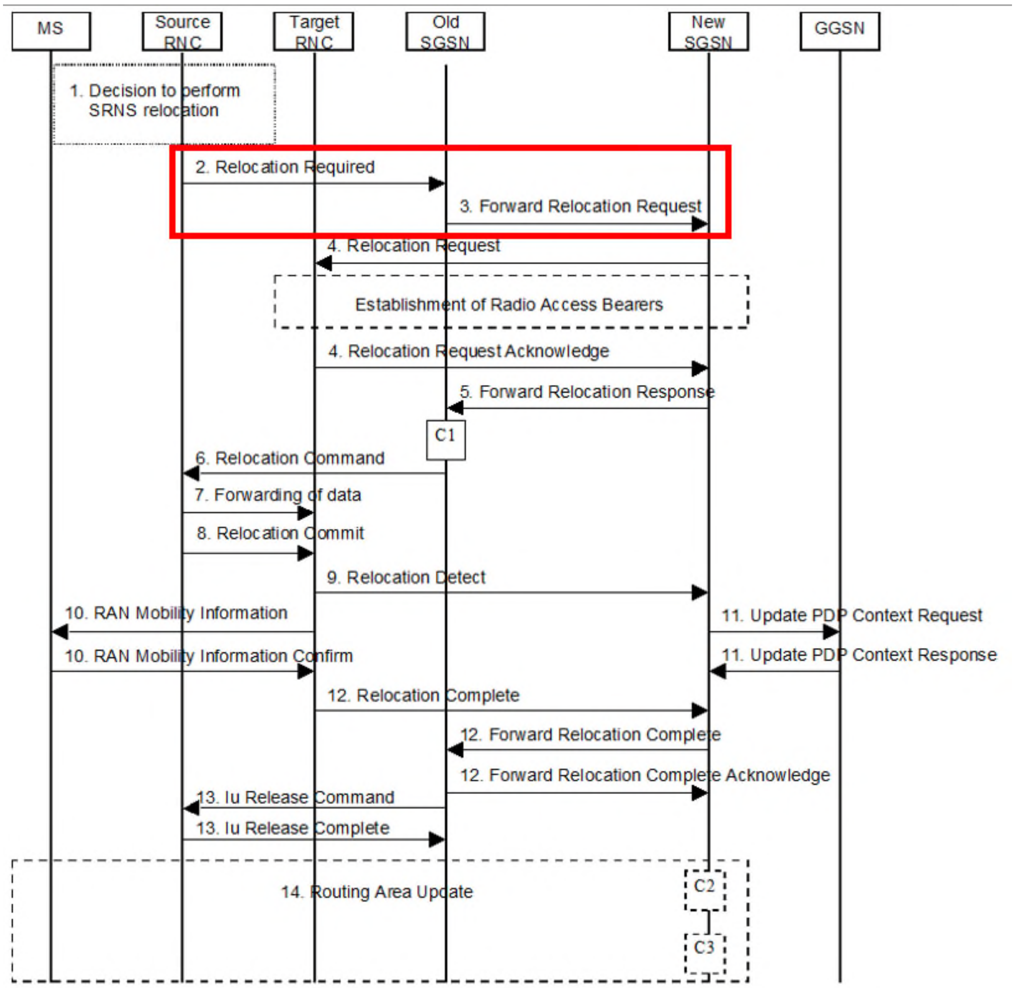


Figure 39: SRNS Relocation Procedure

See 3GPP TS 23.060 v3.1.0 or v5.1.0, § 6.9.2.2.1, Figs. 37-39.

412. The "Forward Relocation Request" is an IP message because GTP over IP may be used to carry signaling messages over the Gn interface between the old SGSN and new SGSN.

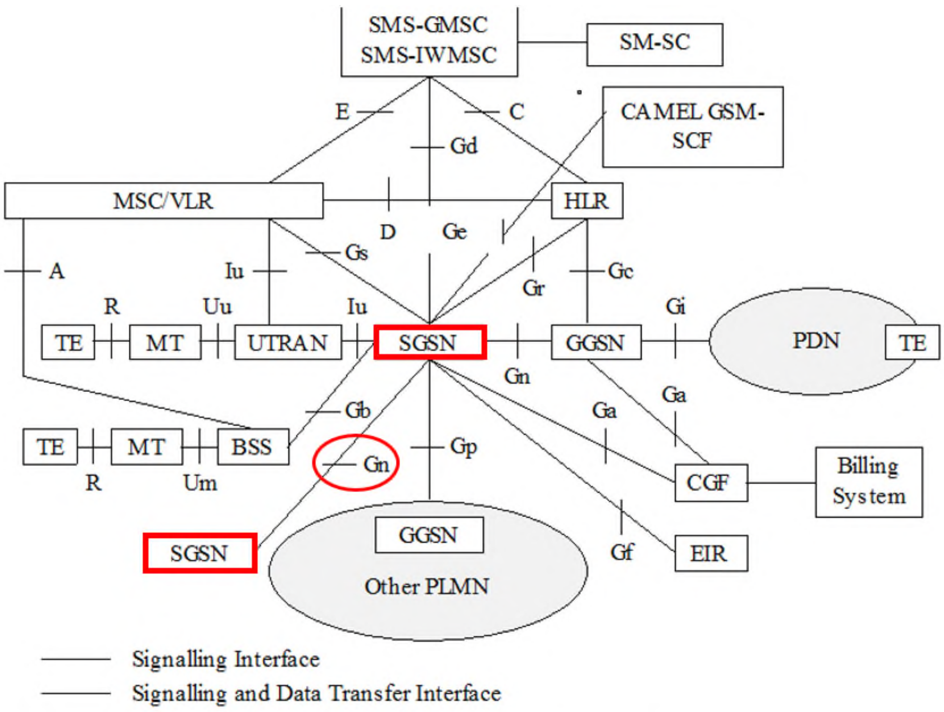


Figure 2: Overview of the GPRS Logical Architecture

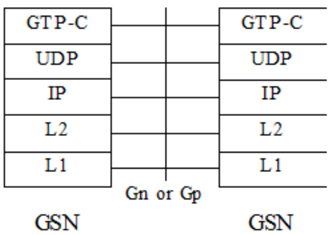


Figure 13: Control Plane for SGSN – GGSN and SGSN – SGSN Interfaces

Id. at §§ 5.4 (Fig. 2), 5.6.3.7 (Fig. 13).

413. The "Forward Relocation Request" sent by the old SGSN to the new SGSN contains "IMSI, Tunnel Endpoint Identifier Signalling, MM Context, PDP Context, Target Identification, RAN transparent container, RANAP Cause" information elements." *Id.* at

§ 6.9.2.2.1. MM Context information includes various information elements, including IMSI, security information, and MS Network Capability information.

Field	Description	A/Gb mode	Iu mode
IMSI	IMSI is the main reference key.	X	X
MM State	Mobility management state, IDLE, STANDBY, READY, PMM-DETACHED, PMM-IDLE, or PMM-CONNECTED.	X	X
P-TMSI	Packet Temporary Mobile Subscriber Identity.	X	X
P-TMSI Signature	A signature used for identification checking purposes.	X	X
IMEI	International Mobile Equipment Identity	X	X
MSISDN	The basic MSISDN of the MS.	X	X
Routeing Area	Current routeing area.	X	X
Cell Identity	Current cell in READY state, last known cell in STANDBY or IDLE state.	X	
Cell Identity Age	Time elapsed since the last LLC PDU was received from the MS at the SGSN.	X	
Service Area Code	Last known SAC when initial UE message was received or Location Reporting procedure was executed.		X
Service Area Code Age	Time elapsed since the last SAC was received at the 3G-SGSN.		X
VLR Number	The VLR number of the MSC/VLR currently serving this MS.	X	X
New SGSN Address	The IP address of the new SGSN where buffered and not sent N-PDUs should be forwarded to.	X	X
Authentication Triplets	GSM Authentication and ciphering parameters.	2)	2)
Authentication Quintets	UMTS Authentication and ciphering parameters.	1)	1)
Kc	Currently used A/Gb mode ciphering key.	X	2)
CKSN	Ciphering key sequence number of Kc.	X	2)
Ciphering algorithm	Selected ciphering algorithm.	X	X
CK	Currently used Iu mode ciphering key.	1)	X
IK	Currently used Iu mode integrity key.	1)	X
KSI	Key Set Identifier.	1)	X
MS Radio Access Capability	MS radio access capabilities.	X	
MS Network Capability	MS network capabilities.	X	X
DRX Parameters	Discontinuous reception parameters.	X	X
MNRG	Indicates whether activity from the MS shall be reported to the HLR.	X	X
NGAF	Indicates whether activity from the MS shall be reported to the MSC/VLR.	X	X
PPF	Indicates whether paging for PS and CS services can be initiated.	X	X
Subscribed Charging Characteristics	The charging characteristics for the MS, e.g. normal, prepaid, flat-rate, and/or hot billing subscription.	X	X
Trace Reference	Identifies a record or a collection of records for a particular trace.	X	X
Trace Type	Indicates the type of trace.	X	X
Trigger Id	Identifies the entity that initiated the trace.	X	X
OMC Identity	Identifies the OMC that shall receive the trace record(s).	X	X
SMS Parameters	SMS-related parameters, e.g. operator-determined barring.	X	X
Recovery	Indicates if HLR or VLR is performing database recovery.	X	X
Radio Priority SMS	The RLC/MAC radio priority level for uplink SMS transmission.	X	
GPRS-CSI	Optional GPRS CAMEL subscription information, see 3GPP TS 23.016	X	X
ODB for PS parameters	Indicates that the status of the operator determined barring for packet oriented services.	X	X
Each MM context contains zero or more of the following PDP contexts:			
PDP Context Identifier	Index of the PDP context.	X	X
PDP State	Packet data protocol state, INACTIVE or ACTIVE.	X	X
PDP Type	PDP type, e.g. PPP or IP.	X	X
PDP Address	PDP address, e.g. an IP address.	X	X
APN Subscribed	The APN received from the HLR.	X	X

Field	Description	A/Gb mode	Iu mode
APN in Use	The APN currently used. This APN shall be composed of the APN Network Identifier and the APN Operator Identifier.	X	X
NSAPI	Network layer Service Access Point Identifier.	X	X
TI	Transaction Identifier.	X	X
TEID for Gn/Gp	Tunnel Endpoint Identifier for the Gn and Gp interfaces.	X	X
TEID for Iu	Tunnel Endpoint Identifier for the Iu interface.		X
GGSN Address in Use	The IP address of the GGSN currently used.	X	X
VPLMN Address Allowed	Specifies whether the MS is allowed to use the APN in the domain of the HPLMN only, or additionally the APN in the domain of the VPLMN.	X	X
QoS Profile Subscribed	The quality of service profile subscribed.	X	X
QoS Profile Requested	The quality of service profile requested.	X	X
QoS Profile Negotiated	The quality of service profile negotiated.	X	X
Radio Priority	The RLC/MAC radio priority level for uplink user data transmission.	X	
Packet Flow Id	Packet flow identifier.	X	
Aggregate BSS QoS Profile Negotiated	The aggregate BSS quality of service profile negotiated for the packet flow that this PDP context belongs to.	X	
Send N-PDU Number	SNDCP sequence number of the next downlink N-PDU to be sent to the MS.	X	
Receive N-PDU Number	SNDCP sequence number of the next uplink N-PDU expected from the MS.	X	
GTP-SND	GTP-U sequence number of the next downlink N-PDU to be sent to the MS.	X	X
GTP-SNU	GTP-U sequence number of the next uplink N-PDU to be sent to the GGSN.	X	X
PDCP-SND	Sequence number of the next downlink in-sequence PDCP-PDU to be sent to the MS.		X
PDCP-SNU	Sequence number of the next uplink in-sequence PDCP-PDU expected from the MS.		X
Charging Id	Charging identifier, identifies charging records generated by SGSN and GGSN.	X	X
PDP Context Charging Characteristics	The charging characteristics of this PDP context, e.g. normal, prepaid, flat-rate, and/or hot billing.	X	X
RNC Address in Use	The IP address of the RNC/BSC currently used.		X

Id. at § 13.2 (Table 6 for MM and PDP Context stored in SGSN); *see also* § 13.4 (Table 8 for MM and PDP Context stored in MS).

414. The same IMSI information, security information (*e.g.*, KSI), and MS Network Capability information (*e.g.*, Core Network Classmark) is sent by the UE to the network in an initial ATTACH REQUEST to connect to an SGSN. *Id.* at §§ 6.5.2, 6.5.3. Under Plaintiff's application of the Court's claim construction, the "Forward Relocation Request" message is a "copy" of the ATTACH REQUEST message the UE sends to the network, because these messages contain the "same" information.

415. In addition, to the extent this limitation is met in the accused LTE network because the Source eNB (alleged ghost-mobile node) allegedly handles signaling required to allocate resources and initiate mobility on behalf of the mobile node, then 3G UMTS standard hard handover and SRNS relocation procedures also meets this limitation.

416. In the hard handover process in the 3G UMTS standard, a Radio Link Setup Request is sent to Target RNC. This Request instructs the Target RNC and Node B to allocate resources to the mobile node and initiates the handover process on the mobile node's behalf, before the mobile node is within the Target RNC's coverage area (under Plaintiff's apparent, but unarticulated interpretation of "coverage area"). *See, e.g.*, 3GPP TR 25.931 v3.1.0 (2000-09), § 7.11.1.1 (including Fig. 27, steps 2 and 3, which is illustrated directly below).

> 2. The target RNC allocates RNTI and radio resources for the RRC connection and the Radio Link(s) (if possible), and sends the NBAP message **Radio Link Setup Request** to the target Node-B.
> Parameters: Cell id, Transport Format Set, Transport Format Combination Set, frequency, UL scrambling code (FDD only), Time Slots (TDD only), User Codes (TDD only), Power control information etc.
> 3. Node B allocates resources, starts PHY reception, and responds with NBAP message **Radio Link Setup Response**.
> Parameters: Signalling link termination, Transport layer addressing information for the Iub Data Transport Bearer.

417. In the SRNS relocation procedures, the Relocation Request instructs the Target RNC to allocate resources to the UE and initiates the relocation procedure on the UE's behalf. *See, e.g.*, 3GPP TS 23.060 v3.5.0, Sections 6.9.2.2.1 (Fig. 39 and step 4), 6.9.2.2.2 (Fig. 42 and step 4); 3GPP TS 23.060 v5.1.0, Sections 6.9.2.2.1 (Fig. 39 and step 4), 6.9.2.2.2 (Fig. 42 and step 4).

418. Plaintiff's Infringement Contentions further allege that the mobile node reports measurements of neighboring cell signals back to the network, which are used to predict when the mobile node will leave its current cell and enter a neighboring cell. Plaintiff explicitly points to Events A3 and A4 in the Measurement Reports. Plaintiff's Infringement Contentions fail to explain how the triggering of signals is based on "a predicted physical location" of the mobile node, as opposed to being based on measuring actual signal strengths for various cells at specified times. In my opinion, the Source eNB does not trigger signals based on a predicted physical location of

the mobile node. Nevertheless, if this infringement analysis is proper for this limitation, then 3G UMTS standard, alone or in combination with Bahl, discloses a ghost-mobile node meeting this limitation.

419. Like the LTE standard's measurement reports identified in Plaintiff's Infringement Contentions, measurement reports are sent from the mobile node in the 3G UMTS standard that contain events, such as a neighbor signal becoming better than a threshold, or a certain amount better than the signal of the node's current cell. These events indicate to the network that a UE/MS will be moving into a new cell (the alleged "predicted physical location"), and trigger a handover to the new cell. *See*, *e.g.*, 3GPP TS 25.331 v3.1.0 (2000-01), §§ 10.2.7 (including subsections 10.2.7.1-10.2.7.44), 14.1 (describe a number of intra-frequency events 1A-1F that may lead to a handover to a new cell), 14.2; 3GPP TS 25.331 v5.1.0, §§ 10.2.7 (including subsections 10.2.7.1-10.2.7.44), 14.1 (describe a number of intra-frequency events 1A-1F that may lead to a handover to a new cell), 14.2; *see also* 3GPP TS 25.331 v3.1.0 (2000-01), §§ 8.1.13, 8.4.1, 9.3.1.4, 9.3.1.5, 9.3.1.6, 9.3.2.6.

420. By way of example, reporting event 1C in Section 14.1.2.3 provides:

14.1.2.3 Reporting event 1C: A non-active primary CPICH becomes better than an active primary CPICH

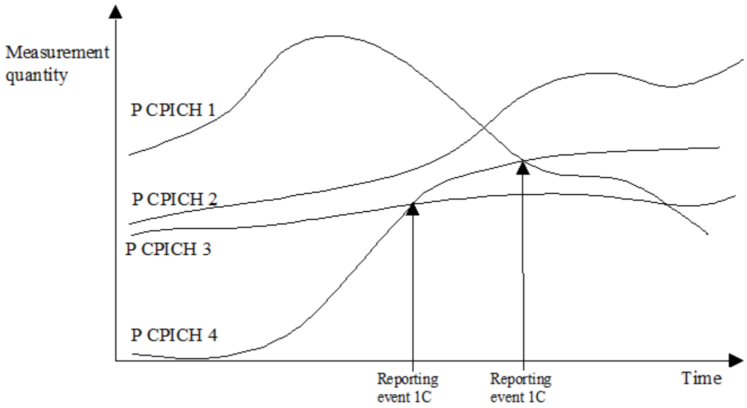


Figure 47: A primary CPICH that is not included in the active set becomes better than a primary CPICH that is in the active set

In this example the cells belonging to primary CPICH 1, 2 and 3 are supposed to be in the active set, but the cell transmitting primary CPICH 4 is not (yet) in the active set.

If a primary CPICH that is not included in the active set becomes better than a primary CPICH that is in the active set, and event 1C has been ordered by UTRAN, this event shall trigger a report to be sent from the UE.

This event may be used for replacing cells in the active set. It is activated if the number of active cells is equal to or greater than a **replacement activation threshold** parameter that UTRAN signals to the UE in the MEASUREMENT CONTROL message. This parameter indicates the minimum number of cells required in the active set for measurement reports triggered by event 1C to be transmitted.

421. Therefore, to the extent this limitation is met in the LTE network, it is also met by the network described in the 3G UMTS standard.

422. Looking next to Bahl, it discloses a ghost-mobile node that creates replica IP messages on behalf of a mobile node, the ghost-mobile node handling signaling required to allocate resources and initiate mobility on behalf of the mobile node, the ghost-mobile node triggering signals based on a predicted physical location of such mobile node or distance with relation to the at least one foreign agent.

423. For example, Bahl describes mobile switching center functionality that may be implemented as computer program modules stored on a base station controller or another network device. *See, e.g.*, Bahl at 10:61-68, 6:66-7:38.

424. Bahl further describes that the mobile switching center module sends a reservation request on behalf of a mobile device to base stations or base transceiver stations in order to reserve bandwidth in those base stations and base transceiver stations of cells along the projected route to reduce latency. *See e.g.*, Bahl at 4:49-61, *also see generally id.* at 4:49-61, 7:15-8:40, 9:66-11:35, 18:5-35, Figs. 5-6, 7B. Bahl further describes a prediction engine that uses a hierarchical location prediction method that predicts the movement of a mobile device at 2 levels – local prediction and global prediction. *Id.* at 11:36-48. Bahl further notes that one criteria that might be used in deciding whether and when to pre-register to a particular cell along the mobile's predicted route is the distance of the cell from the mobile. *See id.* at 11:23-35.

425. If the improved mobility prediction and resource allocation scheme disclosed in Bahl is incorporated in the 3G UMTS standard, then a POSITA would understand that the prediction module could be incorporated into the UE, while the network manager software could be incorporated into the SGSN and RNC components of the 3G UMTS network to effectuate the network resource allocation scheme disclosed in Bahl.

426. When this combination is made, the combination discloses this limitation of claim 1, as described above.

4. <u>Analysis—Claim 4</u>

['417, 4(a)] The system of claim 1, wherein the at least one ghost-mobile node is a proxy element for the at least one foreign agent and the at least one mobile node,

427. The at least one ghost-mobile node identified in my analysis above is a proxy element for the at least one foreign agent and the at least one mobile node.

428. For example, to the extent that the ghost mobile node is deemed to be a proxy element for the foreign agent in the accused LTE network because part of the handover command comes from the target eNB and is transparently forwarded to the UE by the source eNB, then this

portion of this limitation is met in the hard handover procedures of the 3G UMTS standard by the Radio Link Setup Response messages (steps 3 and 5 in Section 7.11.1.1 of TS 25.931) because the SRNC (ghost-mobile node) transparently forwards information from the Target RNC and Target Node B (foreign agent) to the UE. *See, e.g.*, 3GPP TS 25.931 v3.1.0 (2000-09), § 7.11.1.1 (Fig. 27, Steps 3, 5, 7); 3GPP TS 25.931 v5.1.0 (2002-06), § 7.11.1.1 (Fig. 27, Steps 3, 5, 7).

429. Specifically, the Radio Link Setup Response messages sent from the Target RNC to the SRNC contain, among other information, CN PS and CN CS Domain Identifiers (*see* 3GPP TS 25.423 v3.2.0 (2000-06), Sections 9.1.4.1, 9.1.4.2, 9.2.1.12 and 9.2.1.11; 3GPP TS 25.423 v5.1.0 (2002-06), Sections 9.1.4.1, 9.1.4.2, 9.2.1.12 and 9.2.1.11), which include a PLMN Id information element. The PLMN Id may then be forwarded to the UE in the RRC message Physical Channel Reconfiguration. *Compare* 3GPP TS 25.423 v3.2.0 (2000-06), Sections 9.1.4.1 and 9.1.4.2 (or 3GPP TS 25.423 v3.2.0 (2000-06), Sections 9.1.4.1 and 9.1.4.2), *with* 3GPP TS 25.331 v3.1.0 (2000-01), § 10.1.17 (*or* 3GPP TS 25.331 v3.1.0 (2000-01), Sections 10.2.22 and 10.3.1.3).

430. In addition, to the extent Source eNB in the accused LTE network acts as a proxy for the UE by setting up a new X2 interface towards the Target eNB, then the SRNC acts as a proxy for the UE by setting up the Iur interface towards the Target RNC and Target Node B. *See* 3GPP TS 25.931 v3.1.0 (2000-09), § 7.11.1.1 (Fig. 27, Step 1); 3GPP TS 25.931 v5.1.0 (2002-06), § 7.11.1.1 (Fig. 27, Step 1). Finally, to the extent the Source eNB acts a proxy for the MN and manages connection mobility control on its behalf by sending a Handover Request to the Target eNB, which includes UE context information containing the same information sent by the UE upon initial attachment to the network, then the ghost-mobile nodes identified above act as a proxy for the mobile node by performing the same function in the 3G UMTS standard's hard handover and SRNS relocation procedures. *See*, *e.g.*, the citations for limitation 1[f] above.

['417, 4(b)] the at least one ghost-mobile node triggering registration based on a distance to a foreign agent by relaying security and shared secrets from a mobile node, and at least one advertisement message from a foreign agent in a vicinity of the ghost-mobile node.

431. To the extent that the Source eNB receiving a measurement report containing an identifier for a target cell triggers registration based on a distance to a foreign agent, then the SRNC's receipt of similar measurement reports containing cell identity information for target cells also triggers registration based on a distance to a foreign agent. *See, e.g.*, 3GPP TS 25.331 v3.1.0 (2000-01), Sections 8.1.13, 8.4 (including subsections 8.4.1.1-8.4.1.9), 10.2.7.6, 10.2.7.17, 10.2.7.20; 3GPP TS 25.331 v5.1.0 (2002-06), Sections 8.1.13, 8.4 (including subsections 8.4.1.1-8.4.1.9), 10.2.7.6, 10.2.7.17, 10.2.7.20.

432. Furthermore, to the extent the accused LTE network triggers registration based on a distance to a foreign agent because the LocationInfo information element is used to transfer location information available to the UE to the eNB as alleged in the Infringement Contentions, then it is met in the 3GPP UMTS standard because it transfers location information from the UE to the Source RNC. *See, e.g.*, 3GPP TS 23.060 v3.5.0 (2000-10), § 12.7.5 (shown below); 3GPP TS 23.060 v5.1.0 (2002-03), § 12.7.5:

12.7.5 Location Reporting Procedure

This procedure is used by a 3G-SGSN to request the SRNC to report where the MS is currently located, or to report when the MS moves into or out of a given service area. This procedure relates to location services (LCS) and other services (e.g., CAMEL and emergency calls) in UMTS. The overall LCS procedure is to be described in the LCS stage-2 specification, see 3G TS 23.171.

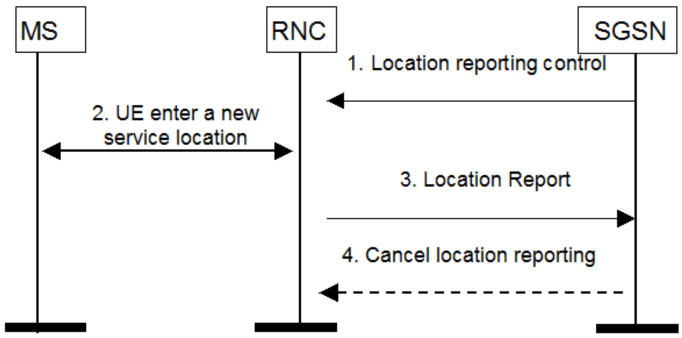


Figure 88: Location Reporting Procedure

See 3GPP TS 23.060 v.3.5.0 (2000-10) at 21-22.

433. In addition, to the extent the accused LTE network triggers registration by relaying security and shared secrets from a mobile node by relaying UE context information to the Target eNB, then this limitation is satisfied in the 3G UMTS standard because UE context information is transferred that includes security information with shared secrets. *See*, *e.g.*, 3GPP TS 25.423 v3.2.0 (2000-06), § 9.1.3 (Radio Link Setup Request—FDD and TDD message, including, but not limited to, the UL scrambling code in the FDD message); 3GPP TS 25.423 v5.1.0 (2002-06), § 9.1.3 (Radio Link Setup Request—FDD and TDD message, including, but not limited to, the UL scrambling code in the FDD message); 3GPP TS 25.331 v5.1.0 Release 5 (2002-06), § 6.14.1.2 (UE capability information is transferred that contains ciphering information); 3GPP TS 23.060 v3.1.0 Release 1999 (2002-10), § 6.9.2.2.1 and 3GPP TS 23.060 v5.1.0 Release 5 (2002-03), § 6.9.2.2.1 (the Forward Relocation Request includes security information security information (*e.g.*, KSI) that is sent by the UE to the network in an initial ATTACH REQUEST to connect to an SGSN)..

434. Finally, Plaintiff's Infringement Contentions addressed the last clause in this limitation ("and at least one advertisement message from a foreign agent in a vicinity of the ghost-mobile node") by alleging that "a foreign agent in the vicinity of the source eNB advertises its Target Cell Identifier (TCI – ECGI/CGI)." The Infringement Contentions lacked such a contention. Nevertheless, consistent with plaintiff's Original Infringement Contentions, the Target RNC sends information in a Radio Link Setup Response message to the SRNC containing, among other information, CN PS and CN CS Domain Identifiers (*see* 3GPP TS 25.423 v3.2.0 (2000-06), Sections 9.1.4.1, 9.1.4.2, 9.2.1.12 and 9.2.1.11), which include a PLMN Id information element. The PLMN Id may then be forwarded to the UE in the RRC message Physical Channel

Reconfiguration as part of the process of "registering" the Target RNC (foreign agent) with the UE. *Compare* 3GPP TS 25.423 v3.2.0 (2000-06), Sections 9.1.4.1 and 9.1.4.2 (or 3GPP TS 25.423 v3.2.0 (2000-06), Sections 9.1.4.1 and 9.1.4.2), *with* 3GPP TS 25.331 v3.1.0 (2000-01), § 10.1.17 (*or* 3GPP TS 25.331 v3.1.0 (2000-01), Sections 10.2.22 and 10.3.1.3).

5. Analysis—Claim 7

['417, 7(a)] A method, in a mobile node, for speeding handover, comprising the steps of:

435. The 3G UMTS standard and Bahl each disclose a method, in a mobile node, for speeding handover. For example, the 3G UMTS standard discloses multiple methods for handing over a mobile station from one base station to another. *See, e.g.*, 3GPP TS 25.931 v3.1.0 (2000-09) at § 7.11.1.1 (Hard Handover via Iur (Dedicated Channel State)); 3GPP TR 25.931 v5.1.0 Release 5 (2002-06) at § 7.11.1.1 (Hard Handover via Iur (DCH State)).

436. Furthermore, Bahl describes managing connections to mobile units in a wireless communications system in order to achieve low-latency handoffs between base stations. *See* Bahl at Abstract, 1:9-22, 1:35-49, 3:40-60 & Figs. 1, 12, 14. For example, Bahl discloses a "method for managing resources in a wireless cellular communications system wherein both intra-cell and inter-cell trajectory of the mobile unit are monitored and subsequently used to predict the path it will take for the purposes of reserving bandwidth and setting up routes ahead of time, reducing hand-off latencies, and relieving congestion in the cells along this predicted path." *See id.* at 3:41-48.

437. I incorporate my analysis above regarding Claims 1 and 4 above.

['417, 7(b)] updating, in a mobile node, a location in a ghost mobile node;

438. The Court construed this limitation to mean "updating the ghost mobile node with a location of the mobile node."

439. It is my understanding that the Plaintiff alleges that the LocationInfo information element in the accused LTE network defined in 3GPP TS 36.331 meets this limitation because it is allegedly used to transfer location information available to the UE to the source eNB. Plaintiff's Infringement Contentions do not explain how the LocationInfo information element bears any relation to the accused X2 or S1 handover processes. As acknowledged by Plaintiff's own Infringement Contentions, the LocationInfo information element is not relevant to the handover decision, rather it is the signal strength measurements that trigger the accused handover processes. Nevertheless, if Plaintiff's infringement analysis is proper for this limitation, then the 3G UMTS standard's location reporting procedures (Release 1999), published in or before September 2000, or subsequent prior art releases (including Release 5), alone or in combination with Bahl, anticipates and/or renders obvious this limitation as referenced below.

440. The 3G UMTS standard and Bahl, alone or in combination, disclose a "ghost mobile node" as discussed above with respect to Claim Element 1(f) above.

441. The 3G UMTS relocation procedure is described in 3GPP TS 25.331 v3.1.0 (2000-01) and 25.331 V5.1.0 (2002-06), and the mobility management functionality, including SRNS (SRNC) relocation procedures, is described in 3GPP 23.060 v3.5.0 (2000-10) and 3GPP 23.060 v5.1.0 (2002-03).

442. Similar to Plaintiff's Infringement Contentions, in the network communications system described in the 3GPP standard publications TS 23.060 and TS 25.331, the serving RNC (*i.e.*, "ghost mobile node") in connection with the SGSN is updated with the location of the mobile station (*i.e.*, "mobile node") when the mobile station moves into or out of a given service area. 3GPP TS 23.060 v.3.5.0 (2000-10) at § 12.7.5.

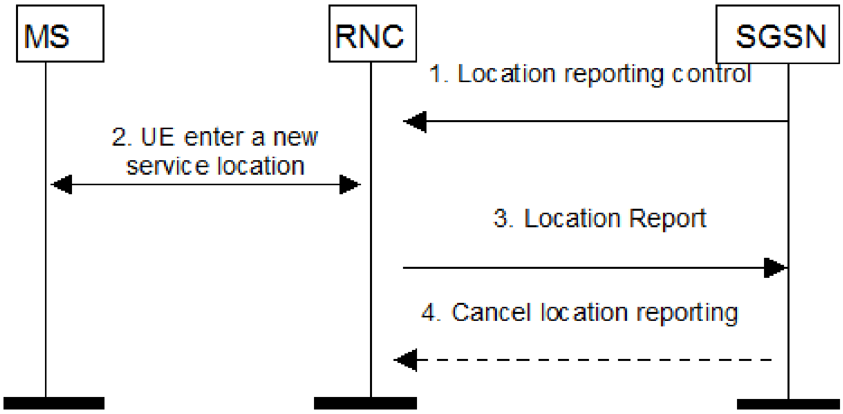


Figure 88: Location Reporting Procedure

443. Likewise, Bahl evidences that "[l]ocation management or location tracking incorporate[ing] a set of mechanisms with which the network can locate a particular mobile at any given time" was well known in the art well before the priority date of the '417 Patent. *See* Bahl at 2:37-52. Bahl further discloses a "method for managing resources in a wireless cellular communications system wherein both intra-cell and inter-cell trajectory of the mobile unit are monitored and subsequently used to predict the path it will take for the purposes of reserving bandwidth and setting up routes ahead of time, reducing hand-off latencies, and relieving congestion in the cells along this predicted path." *See id.* at 3:41-60.

444. Bahl further discloses:

> As long as the mobile follows the assumed UMP, updating of the mobile's location is not necessary, since the BTS of the current cell has informed the BTS of the cells in the predicted path by way of the BSC and the MSC (see FIG. **1**). Therefore, the mobile can continue to use the network services without conventional registration and location updating procedures when it transitions into a new cell or arrives at a new zone.
>
> In the special case when no UMP is found to match UAP, conventional methods for updating the location of the mobile are enabled to collect location information in keeping with conventional practice. As most mobile users are quite regular in their daily movement, however, the invention results in a significant reduction in signaling traffic due to location updating.

Id. at 19:17-31.

['417, 7(c)] determining a distance, in the ghost mobile node in communication with the mobile node, to a closest foreign agent with which the mobile node can complete a handover;

445. Plaintiff's Infringement Contentions allege that the signal strength measurement reports from the mobile node contain events, such as Neighbor signal becoming better than a threshold, or a certain amount better than the signal of the node's current cell, and that these events indicate to the network that a mobile node will be moving into a new cell. Plaintiff explicitly points to Events A3 and A4 in the Measurement Reports. Plaintiff's Infringement Contentions fail to explain how these signal strength measurements constitute "determining a distance … to a closest foreign agent." In my opinion, signal strength measurements do not constitute determining a distance; they are simply measurements of actual signal strengths for various cells at specified times. Nevertheless, if this infringement analysis is proper for this limitation, then the prior art 3G UMTS standard and Bahl, alone or in combination, disclose this limitation.

446. Like the LTE standard's measurement reports identified in Plaintiff's Infringement Contentions, the measurement reports from the mobile node (MS) in the 3G UMTS standard contain events, such as a neighbor signal becoming better than a threshold, or a certain amount better than the signal of the node's current cell. These events indicate to the network that a UE/MS is in a new cell (the alleged "predicted physical location"), and trigger a handover to the new cell. *See, e.g.*, 3GPP TS 23.060 v.3.5.0 (2000-10) at §§ 6.9.2.2.1 (Fig. 39 and steps 13), 6.9.2.2.2 (Fig. 42 and steps 1-3); 3GPP TS 23.060 v.3.5.0 v.5.1.0 (2002-03) at § 6.9.2; 3GPP TS 25.331 v3.1.0 (2000-01) at §§ 10.2.7, 14.1, 14.1.2 (describes a number of intra-frequency reporting events 1A-1F that may lead to a handover to a new cell, including events 1E and 1F, which include a predetermined threshold), 14.2; 3GPP TS 25.331 v.5.1.0 (2002-06) at §§ 10.3.7, 14.1, 14.1.2.

447. By way of example, reporting event 1C in Section 14.1.2.3 provides:

14.1.2.3 Reporting event 1C: A non-active primary CPICH becomes better than an active primary CPICH

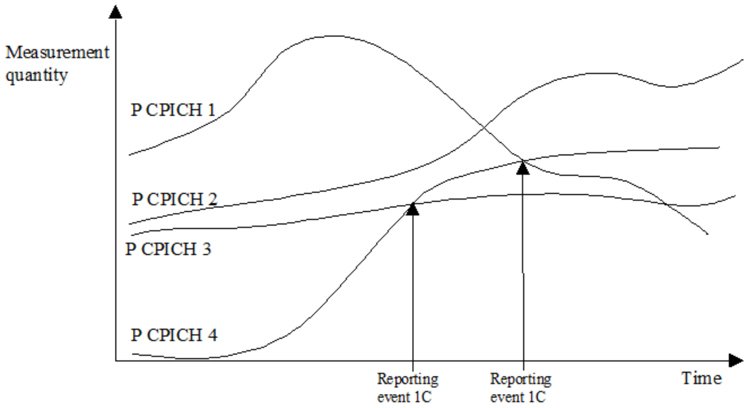


Figure 47: A primary CPICH that is not included in the active set becomes better than a primary CPICH that is in the active set

In this example the cells belonging to primary CPICH 1, 2 and 3 are supposed to be in the active set, but the cell transmitting primary CPICH 4 is not (yet) in the active set.

If a primary CPICH that is not included in the active set becomes better than a primary CPICH that is in the active set, and event 1C has been ordered by UTRAN, this event shall trigger a report to be sent from the UE.

This event may be used for replacing cells in the active set. It is activated if the number of active cells is equal to or greater than a **replacement activation threshold** parameter that UTRAN signals to the UE in the MEASUREMENT CONTROL message. This parameter indicates the minimum number of cells required in the active set for measurement reports triggered by event 1C to be transmitted.

448. It is further my understanding that the Plaintiff alleges that the LocationInfo information element in the accused LTE network defined in 3GPP TS 36.331 meets this limitation because it is allegedly used to transfer location information available to the UE to the source eNB. Plaintiff's Infringement Contentions do not explain how the LocationInfo information element bears any relation to the accused X2 or S1 handover processes. As acknowledged by Plaintiff's own Infringement Contentions, the LocationInfo information element is not relevant to the handover decision, rather it is the signal strength measurements that trigger the accused handover processes. Nevertheless, if this infringement analysis is proper for this limitation, then the prior art 3G UMTS standard and Bahl, alone or in combination, disclose this limitation for the reasons discussed above in Claim Element 7(b).

['417, 7(d)] submitting on behalf of the mobile node, from the ghost mobile node, a registration to the foreign agent to which the mobile node is going to complete the handover; and

449. The 3G UMTS standard and Bahl, alone or in combination, disclose submitting on behalf of the mobile node, from the ghost mobile node, a registration to the foreign agent to which the mobile node is going to complete the handover.

450. For example, in the hard handover process in the 3G UMTS standard, a Radio Link Setup Request is sent to Target RNC. This Request instructs the Target RNC and Node B to allocate resources to the mobile node and initiates the handover process on the mobile node's behalf, before the mobile node is within the Target RNC's coverage area (under Plaintiff's apparent, but unarticulated interpretation of "coverage area"). *See, e.g.*, 3GPP TR 25.931 v3.1.0 (2000-09), § 7.11.1.1 (including Fig. 27, steps 2 and 3, which is illustrated directly below).

2. The target RNC allocates RNTI and radio resources for the RRC connection and the Radio Link(s) (if possible), and sends the NBAP message **Radio Link Setup Request** to the target Node-B.
   Parameters: Cell id, Transport Format Set, Transport Format Combination Set, frequency, UL scrambling code (FDD only), Time Slots (TDD only), User Codes (TDD only), Power control information etc.
3. Node B allocates resources, starts PHY reception, and responds with NBAP message **Radio Link Setup Response**.
   Parameters: Signalling link termination, Transport layer addressing information for the Iub Data Transport Bearer.

451. Furthermore, in the SRNS relocation procedures in the 3G UMTS standard, the Relocation Request instructs the Target RNC to allocate resources to the UE and initiates the relocation procedure on the UE's behalf. *See, e.g.*, 3GPP TS 23.060 v3.5.0, Sections 6.9.2.2.1 (Fig. 39 and step 4), 6.9.2.2.2 (Fig. 42 and step 4); 3GPP TS 23.060 v5.1.0, Sections 6.9.2.2.1 (Fig. 39 and step 4), 6.9.2.2.2 (Fig. 42 and step 4).

452. Similarly, Bahl describes a mobile switching center that can be implemented as a module on a base station controller or a network device. Bahl further describes that the mobile switching center module sends a reservation request on behalf of a mobile device to base stations or base transceiver stations in order to reserve bandwidth in those base stations or base transceiver stations of cells along the projected route to reduce latency. Bahl additionally

describes that the mobile switching center initiates the reservation request in response to predicted route information to a base station. *See, e.g.*, Bahl at 4:49-61, 7:15-19, 8:8-16, 9:66-11:35, 18:5-35 & Fig. 6. For example, Bahl discloses:

> One example of a method the MSC may employ to manage the allocation of channel assignments in an effort to maintain the connection is illustrated in the flow diagram of FIG. **6**. The process begins at step **115**. At step **117**, the MSC receives trajectory of prediction information from the mobile unit in keeping with the invention by way of one of the BTSs and the associated BSC. At step **119**, the MSC determines whether the prediction is a new prediction or an update of a previous prediction. If the prediction is an update the process branches to step **123**, where the new prediction replaces the old one. Otherwise, the process branches to step **121**, where the process sets up a reservation request for the mobile unit in the cells identified by the UMP or the local prediction.

Id. at 11:9-22.

[‘417, 7(e)] upon completing the handover, updating a registration in the mobile node.

453. It is my understanding that Plaintiff alleges that in the accused LTE network the target eNB updates a registration in the mobile node by providing uplink allocation and timing advance information to the UE, thereby satisfying this limitation. In my opinion, Plaintiff’s allegations do not make sense because *inter alia* in the accused LTE network registration must occur before handover is complete. Nevertheless, if Plaintiff’s infringement analysis is proper for this limitation, then the prior art 3G UMTS standard discloses this limitation.

454. Similar to Plaintiff’s Infringement Contentions, in the network communications system described in the 3GPP standard publications TS 23.060 and TS 25.331, the target RNC updates a registration in the mobile station by providing uplink allocation and timing information to the mobile station. For example, in the serving SRNS relation procedure in the 3G UMTS standard:

> After having sent the Relocation Detect message, target SRNC responds to the MS by sending a RNTI Reallocation message. Both

messages contain UE information elements and CN information elements. The UE information elements include among others new SRNC identity and S-RNTI. The CN information elements contain among others Location Area Identification and Routeing Area Identification. The procedure shall be coordinated in all Iu signalling connections existing for the MS.

The target SRNC resets and restarts the RLC connections, and exchanges the PDCP sequence numbers (PDCP-SNU, PDCP-SND) between the target SRNC and the MS. PDCP-SND is the PDCP sequence number for the next expected in-sequence downlink packet to be received in acknowledged mode in the MS per radio bearer, which requires lossless relocation. PDCP-SND confirms all mobile-terminated packets successfully transferred before the start of the relocation procedure.

3GPP TS 23.060 v.3.5.0 (2000-10) at §§ 6.9.2.2.1.

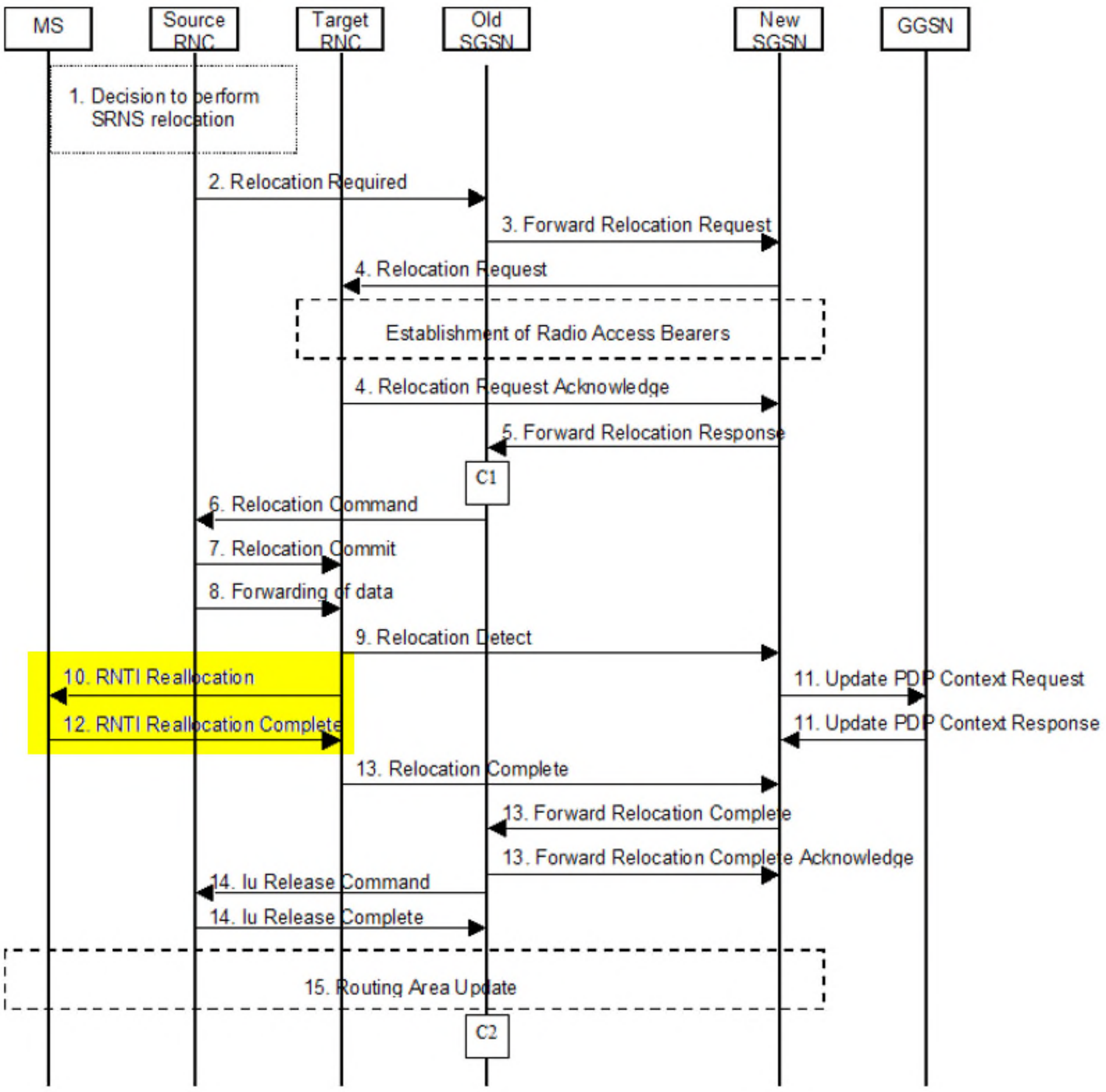


Figure 39: Serving SRNS Relocation Procedure

Id. at Fig. 39.

455. Similarly, with respect to the combined hard handover and SRNS relocation procedure:

> Upon reception of the Relocation Command message from the PS domain, the source RNC shall start the data-forwarding timer. When the relocation preparation procedure is terminated successfully and the source SRNC is ready, then the source SRNC shall trigger the execution of relocation of SRNS by sending to the MS the RRC message provided in the Target RNC to source RNC transparent container, e.g., a Physical Channel Reconfiguration (UE

> Information Elements, CN Information Elements) message. UE Information Elements include among others new SRNC identity and S-RNTI. CN Information Elements contain among others Location Area Identification and Routeing Area Identification. Before the RRC message is sent (e.g., Physical Channel Reconfiguration) uplink and downlink data transfer in the source SRNC shall be suspended for RABs which requires loss-less relocation.
>
> …
>
> When the MS has reconfigured itself, it sends e.g., a Physical Channel Reconfiguration Complete message to the target SRNC. From now on the exchange of packets with the MS can start.

Id. at § 6.9.2.2.2.

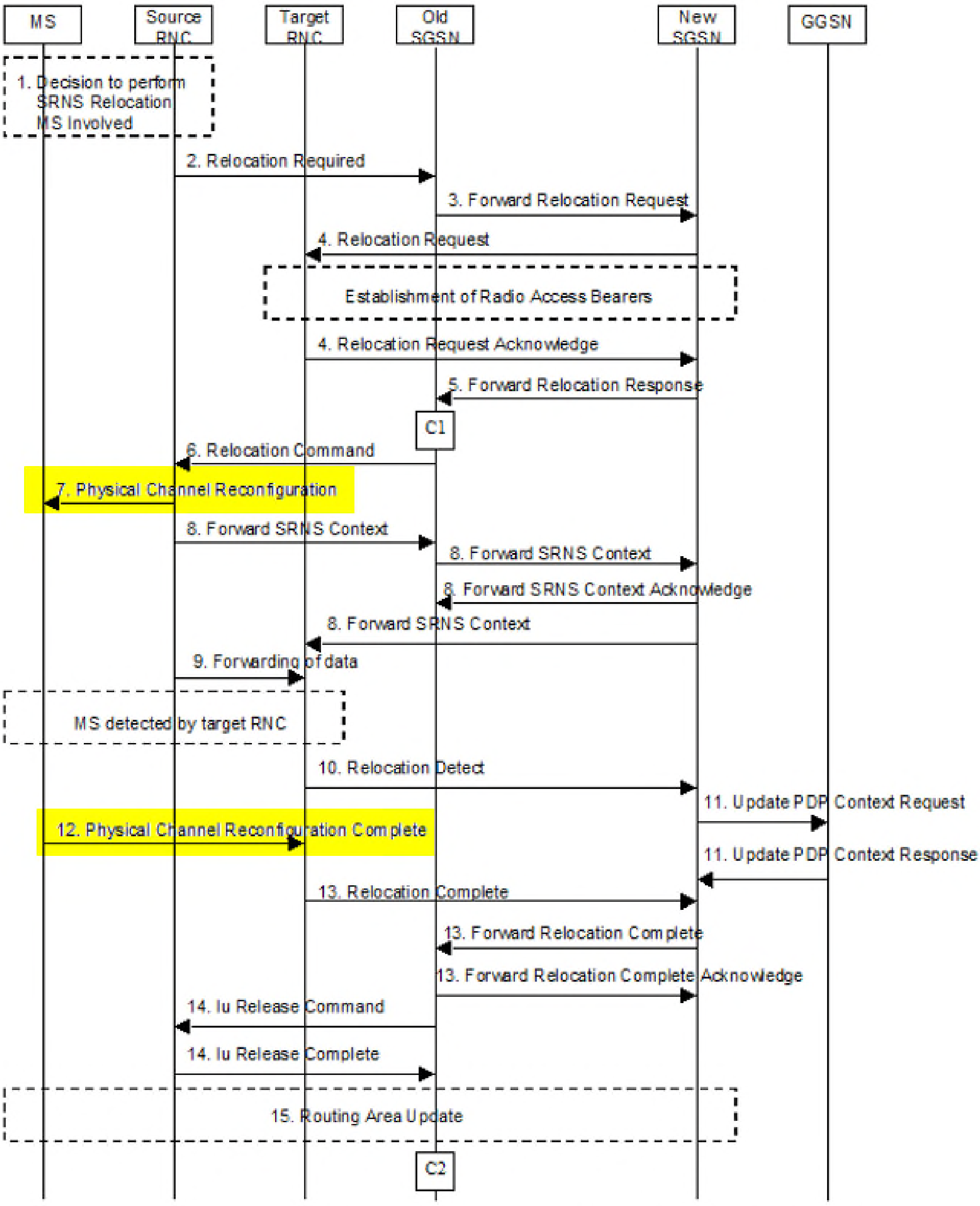


Figure 42: Combined Hard Handover and SRNS Relocation Procedure

Id. at Fig. 42.

456. Therefore, to the extent this limitation is met in the LTE network, it is also met by the network described in Shimizu alone or in combination with the 3G UMTS standard.

D. Under Plaintiff's Interpretation of the Asserted Claims, Gwon Anticipates or Render Obvious the Asserted Claims

457. As I understand Plaintiff's Infringement Contentions, based on the limited infringement analysis provided therein, it appears that Plaintiff contends, among other things, that: (1) replica IP messages are created in the accused LTE network even though the information sent by the UE upon initial attachment to the network is not sent in an IP message, and (2) the mobile node is outside the coverage area of the target eNB at the time a handover decision is made. While I disagree with these infringement positions, if they are correct then the Asserted Claims are invalid based Gwon I, alone or in combination with Gwon II.

1. Gwon

458. U.S. Patent Publication No. US 2002/0131386 A1 ("Gwon I"), was published on September 19, 2002, from an application filed on January 26, 2001. It therefore qualifies as prior art under 35 U.S.C. §§ 102(a) and (e) (pre-AIA). Gwon I was not cited or considered during the prosecution of the '417 Patent. Gwon I discloses that:

> The mobile node 135 may identify available local routers using the Neighbor Discovery methodology described in RFC 2461 and the IETF Mobile IP version 6 draft document (section 10.4). Thus, the mobile node 135 may broadcast Router Solicitation messages to determine if any local routers are available, or may wait to receive unsolicited multicast Router Advertisement messages from available routers. . . . In either event, the mobile node will have identified new local router R2 with which to establish its new network connection.

Gwon I at ¶ 53.

459. U.S. Patent Publication No. 2003/0016655 ("Gwon II"), was published on January 23, 2003, from an application filed on January 29, 2001. It therefore qualifies as prior art under 35 U.S.C. §§ 102(a) and (e) (pre-AIA). Gwon II incorporates Gwon I by reference. *See* Gwon II at ¶¶ 1, 61. Gwon II was considered during the prosecution of the '508 Patent. Both Gwon I and

Gwon II disclosed methods for predicting the mobility of mobile nodes in wireless networks to enable fast route pre-establishment and reduced packet latency.

2. Analysis—Claim 1

[‘417, 1(a)] A system for communicating between a mobile node and a communication network; the network having at least one communications network node that is interconnected using a proxy mobile internet protocol (IP), comprising:

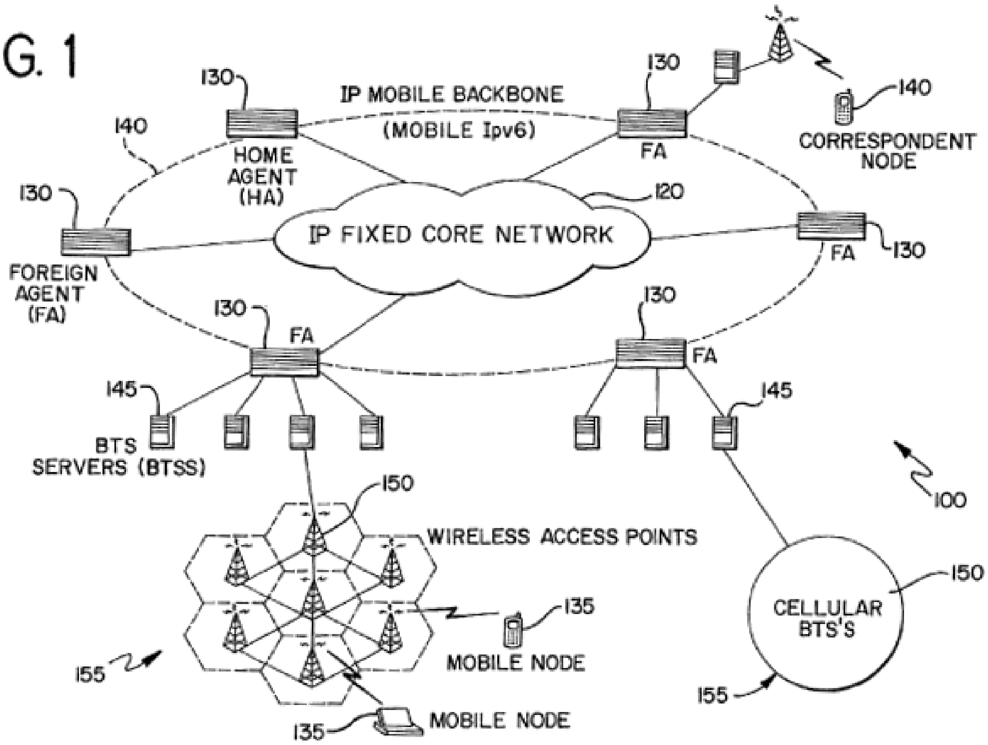
460. Gwon I discloses a system for communicating between a mobile node and a communications network. Unless otherwise stated, references to “Gwon” are to Gwon I rather than Gwon II in the discussion below. For example, Gwon discloses the communication of digital data in third generation and beyond wireless, mobile-access, Internet protocol-based data networks, Mobile IP, and wireless LANs. *See, e.g.*, Gwon at Abstract, ¶¶ 2–25, ¶¶ 36–47, Figs. 1–2.

461. For example, the Abstract of Gwon provides:

> “Disclosed are methods for predicting the mobility of mobile nodes in third generation and beyond wireless, mobile access Internet protocol-based data networks embodying IETF Mobile IP support, as well as in wireless LANs. Conventional Mobile IP mobility detection is replaced with deterministic, stochastic, and/or adaptive methods to predict the mobility of a mobile node in the network employing network logic layer (L3) packet latency characteristics. The method is useful for providing pre-notification that a communication hand-off condition is imminent to enable fast route pre-establishment and reduced packet latency, and for optimizing quality of service by facilitating selection of best base station transceiver in overlapping cell environments, among other applications.”

462. Figure 1 of Gwon is reproduced below:

FIG. 1



463. Gwon discloses the network having at least one communications network node that is interconnected using a proxy mobile internet protocol (IP). The IETF Mobile IP version 4 and version 6 standards, including RFC 1573, 2002, 2401, 2402, 2406, 2460, 2461, and 2462, are incorporated by reference in Gwon. *See, e.g.*, *id.* at ¶¶ 7, 37–39, 49–53. More specifically, Gwon states that "the mobile node (MN) **135** can employ the Neighbor Discovery methodology specified in IETF RFC 2461, which is incorporated herein by reference…." *Id.* at ¶ 51.

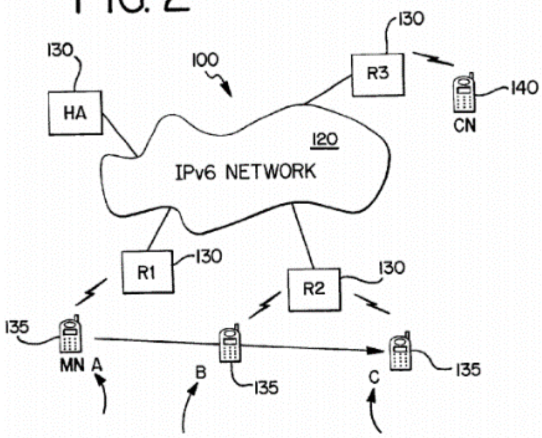
464. The Neighbor Discovery protocol described in RFC 2461 can include a proxy that can act on behalf of another node or router on the network. *See, e.g.*, *id.* at ¶¶ 49–53, Fig. 1; IETF RFC 2461 at 6, 65. For example, RFC 2461 indicates that a router may act as proxy for the node: "proxy - a router that responds to Neighbor Discovery query messages on behalf of another node. A router acting on behalf of a mobile node that has moved off-link could potentially act as a proxy for the mobile node." RFC 2461 at 6.

465. In addition, RFC 2461 further provides that "a router MAY proxy for one or more other nodes, that is, through Neighbor Advertisements indicate that it is willing to accept packets not explicitly addressed to itself. For example, a router might accept packets on behalf of a mobile node that has moved off-link." *Id.* at 65.

['417, 1(b)] at least one mobile node;

466. Gwon discloses at least one mobile node. For example, Gwon discloses a plurality of mobile nodes (MNs) connected to a network. *See, e.g.*, Gwon at ¶ 43, ¶¶48–54, Figs. 1 (shown above) and 2 (shown below).

FIG. 2



['417, 1(c) & 1(d)] at least one home agent; at least one foreign agent;

467. Gwon discloses at least one home agent and at least one foreign agent. For example, Gwon discloses a plurality of local routers (functioning as home agents and foreign agents) in an IP-based network. *See, e.g.*, Gwon at Abstract, ¶ 39, ¶¶ 41–43, ¶¶ 48–49, Figs. 1–2.

468. By way of example, Gwon states:

> Built on the core network **120** is a collection of servers/routers **130** which comprise an IP mobile backbone **140**. The servers/routers **130** comprising the IP mobile backbone are themselves nodes of the core network **120** and are interconnected via the core network **120**. ***The***

> ***servers/routers 130 function as home agents (HA) and foreign agents (FA) to interface mobile nodes 135 and mobile correspondent nodes 140 to the core network 120***, as specified in IETF RFC 2002 ("Mobile IP Version 4"), which is incorporated herein by reference. Mobile nodes may comprise any number of different kinds of mobile, wireless communication devices including cellular handsets, cellular telephones, hand-held computers, personal information managers, wireless data terminals, and the like.

Gwon at ¶ 39 (emphasis added).

['417, 1(e)] a ghost-foreign agent that advertises messages to one of the mobile nodes indicating presence of the ghost-foreign agent on behalf of one of the foreign agents when the mobile node is located in a geographical area where the foreign agent is not physically present;

469. Plaintiff's Infringement Contentions do not explain why the accused "advertisement messages" are sent to the mobile node "when [it] is located in a geographic area where the foreign agent is not physically present" (which has been construed to mean "when the mobile node is located outside the region covered by the foreign agent"). In my opinion, the RRC and SIB messages (the alleged "advertisement messages") are sent to, and received by, the mobile node when it is within the coverage area of the target eNB (the alleged foreign agent). Nevertheless, if this infringement analysis is proper for this limitation, then Gwon discloses a ghost-foreign agent that advertises messages to a mobile node indicating the presence of the ghost-foreign agent on behalf of one of the foreign agents when the mobile node is located in a geographical area where the foreign agent is not physically present.

470. For example, Gwon describes a predictive mobility scheme in which local routers acting as foreign agents are able to announce their presence to a mobile node using the Neighbor Discovery methodology specified in the RFC 2461. Under Plaintiff's apparent interpretation of the Court's claim construction, a mobile node registered to a first local router R1 can be made aware

of the presence of a second local router R2 when the mobile node is located outside the region covered by the second local router R2.

471. Specifically, the local router R2 acting as a foreign agent can announce its presence to the mobile node using a Router Advertisement message and/or Neighbor Advertisement message. In the Neighbor Discovery procedure, the local router R1 can act as a proxy for the local router R2 (foreign agent) by making the mobile node aware of Neighbor Advertisement messages or unsolicited Router Advertisement messages from the local router before a layer 2 connection is made to the local router R2. *See, e.g.*, *id*. at Abstract, ¶¶ 51-52, Figs. 1-2; RFC 2461 at 6, 11, 13, 65. For example, Gwon provide:

> Alternatively or additionally, the mobile node (MN) 135 can employ the Neighbor Discovery methodology specified in IETF RFC 2461, which is incorporated herein by reference, and which is recommended for Mobile IP version 6 mobile nodes in the IETF Mobile IP Version 6 draft document (section 10.4) previously identified and incorporated by reference. In this methodology, the mobile node 135 uses so-called Neighbor Unreachability Detection (1) to detect TCP acknowledgements of data packets sent to its local router R1, and/or (2) to receive Neighbor Advertisement messages from its local router R1 in response to Neighbor Solicitation messages from other mobile node devices in the area, and/or (3) to receive unsolicited Router Advertisement messages from its local router R1. The receipt of TCP acknowledgements indicates the mobile node's network connection via the local router R1 is still viable. The receipt of Neighbor Advertisement and/or Router Advertisement messages indicates the presence of other local routers which could provide network connections for the mobile node.
>
> At some point as mobile node 135 reaches intermediary location B and continues toward location C, its network connection via local router R1 begins to degrade. The degradation is typically detected as described in the preceding paragraphs based on a loss of signal strength or reduction in signal quality, and/or as the loss of TCP acknowledgements or the detected presence of other local routers. Conventionally, the internal programming of the mobile node device is such that once a preset threshold is reached, the mobile node 135 seeks to identify a new local router and to establish a new

> network connection via that router to replace its degraded network connection via local router R1.

Gwon at ¶¶ 51-52.

472. Additionally or alternatively, to the extent Plaintiff's infringement analysis is correct, Gwon II discloses that a mobile node can receive advertisement messages from a ghost foreign agent indicating the presence of a target foreign agent while the mobile node is located outside the region covered by the target foreign agent. Gwon II clarifies that a mobile node can receive advertisement messages indicating the presence of neighboring foreign agents (or local routers) through its current local router before any layer 2 connection is made between the mobile node and any neighboring foreign agent. For example, Gwon II states:

> Through the mobility prediction analysis **710**, the mobile node **135** can predict future latency of packets that the mobile node **135** would have to undergo in communication with each of nearby foreign agents **145**. Based on the predicted packet latency, the mobile node **135** selects one or more candidate foreign agents **145** to which it can hand off its network communications link. Thus, ***through the mobility prediction analysis 710, the mobile node 135 can determine a next foreign agent 145 sufficiently before actual hand-off is required***.

> After the mobile node **135** determines one or more next foreign agents **145**, it then carries out a service availability check to determine whether service is available from the next foreign agents **145** … In mobile IP version 4 networks, the mobile node **135** can obtain such information by intercepting Mobile IP Agent Advertisement Messages broadcast by the next agents **145**. Alternatively, the mobile node **135** may obtain the information actively by sending Agent Solicitation Messages. Agent Advertisement Messages and Agent Solicitation Messages are specified in the proposed Mobile IP version 4 document previously identified and incorporated herein by reference. In Mobile IP version 6 networks, the mobile node can obtain the requisite information about the next foreign agent **145** by way of the Neighbor Discovery procedures of IETF RFC 2461 or by using the Router Solicitation procedures specified in the Mobile IP version 6 document identified previously and incorporated herein by reference.

> Once the mobile node **135** has obtained the information necessary to communicate with the next foreign agent **145**, it undertakes a pre-registration process **720** with the mobile node's home agent (HA) **145**. … Thus, the mobile node prepares and sends a Registration Request to the next foreign agent **145**. If the Layer 2 communication channel is already established, the Registration Request is directly sent from the mobile node **135** to the next agent **145**. ***If the Layer 2 communication channel is not yet established, the Registration Request is sent to the next foreign agent 145 through the current foreign agent 145***.

Gwon II at ¶¶ 74-76 (emphasis added).

['417, 1(f)] a ghost-mobile node that creates replica IP messages on behalf of a mobile node, the ghost-mobile node handling signaling required to allocate resources and initiate mobility on behalf of the mobile node, the ghost-mobile node triggering signals based on a predicted physical location of such mobile node or distance with relation to the at least one foreign agent.

473. Plaintiff's Infringement Contentions allege that a Handover Request is the replica IP message created by the ghost-mobile node (alleged to be the Source eNB) and that such Handover Request instructs the Target eNB to allocate resources to the mobile node and initiates the handover process on its behalf, but these contentions fail to explain how the Source eNB is capable of registering with a foreign agent and allocating resources for the mobile node before the it arrives in the physical area covered by the foreign agent. In my opinion, the Source eNB cannot register and allocate resources for the mobile node before the mobile node arrives in the physical area covered by the foreign agent. Nevertheless, if this infringement analysis is proper for this limitation, then Gwon I in combination with Gwon II discloses this limitation.

474. As an initial matter, it would have been obvious for a POSITA to combine Gwon I and Gwon II because Gwon II incorporates by reference Gwon I's entire specification as disclosing a related mobility detection analysis. *See* Gwon II at ¶¶ 1, 61.

475. Gwon II disclose that the mobility prediction can be done on the mobile node's local agent or router, instead of on the mobile node itself. *Id.* at ¶ 59 ("Alternatively, however, the

mobility prediction can be performed in the processor facilities and stored programming of the mobile node's local agent 145 and communicated to the mobile node the same as any other data in the network.")

476. Gwon II further discloses that after the mobile node obtains the information needed to communicate with the next foreign agent (*i.e.*, the mobile node's predicted next connection point), a pre-registration process is carried out with the mobile node's home agent that is the same process the mobile node would otherwise follow to register with a new foreign agent under the procedures set forth in the Mobile IP standard. *Id.* at ¶ 86 & Figs. 1, 2. Specifically, Gwon II provides:

> Once the mobile node 135 has obtained the information necessary to communicate with the next foreign agent 145, it undertakes a pre-registration process 720 with the mobile node's home agent (HA) 145. If necessary, the pre-registration process 720 is also carried out with a gateway router in the domain to which the next foreign agent 145 belongs. The pre-registration process 720 is the same process the mobile node 135 would otherwise follow to register with a new foreign agent 145 during the hand-off procedure as specified in the Mobile IP version 4 and version 6 documents. Thus, the mobile node prepares and sends a Registration Request to the next foreign agent 145. If the Layer 2 communication channel is already established, the Registration Request is directly sent from the mobile node 135 to the next agent 145. If the Layer 2 communication channel is not yet established, the Registration Request is sent to the next foreign agent 145 through the current foreign agent 145.

Id. at ¶ 76.

477. When the Layer 2 communication channel is not yet established between the mobile node and the next foreign agent, the Registration Request is a replica IP message that is sent from the current foreign agent (local router R1 acting as a ghost-mobile node) on the mobile node's behalf to register, allocate resources, and initiate mobility for the mobile node. *Id.* The Registration Request is replica IP message because it is the same Mobile IP registration message that would otherwise be sent by the mobile node. *Id.*

478. Under Plaintiff's apparent interpretation of the claims, this Registration Request from the current router to the next router in the example provided above is sent before the mobile node arrives in the physical area covered by the foreign agent because the mobile node lacks a Layer 2 communication channel with the next foreign agent at the time the Registration Request is sent. *See id.*

479. Additionally, Gwon II alone or in combination with Gwon I discloses that the ghost-mobile node (local router R1) triggers the Registration Request signal based on a "predicted physical location of the mobile node or distance with relation to the at least one foreign agent," under Plaintiff's apparent interpretation of this phrase.

> Through the mobility prediction analysis 710, the mobile node 135 can predict future latency of packets that the mobile node 135 would have to undergo in communication with each of nearby foreign agents 145. Based on the predicted packet latency, the mobile node 135 selects one or more candidate foreign agents 145 to which it can hand off its network communications link. Thus, through the mobility prediction analysis 710, the mobile node 135 can determine a next foreign agent 145 sufficiently before actual hand-off is required.

Id. at ¶ 74; *see also* Gwon I at ¶¶ 59-60, 76, 103.

480. Specifically, in the deterministic method of mobility prediction analysis described in Gwon I, the hand-off is triggered using a Registration Request based the distance "d" between the mobile node and the BTS connected to the foreign agent:

> "Except d, which is the distance between the BTS and the mobile node, all of the parameters of Equation (8) are system parameters obtainable from either layer 2 or layer 3 programming of the mobile node. Thus, in the deterministic method, d is determined by measurement and is then applied to Equation (8) to solve for τ. There are a number of potential ways to measure d. If a number of BTS cells are present such that the mobile node is receiving beacon signals from at least three BTS', conventional triangulation techniques based on relative beacon signal strength measurements can be used to determine the mobile node's distance from each BTS. Another way is to use GPS….

> The predicted future latency value τ may then be compared to a predetermined threshold value to trigger a desired action or used to optimize the mobile node's network connection as previously described. The same considerations relating to the measurement of distance and selection of the time index for predictions of latency τ expressed with respect to the deterministic method also apply to the stochastic method.

Gwon at ¶¶ 76, 84.

3. Analysis—Claim 4

[‘417, 4(a)] The system of claim 1, wherein the at least one ghost-mobile node is a proxy element for the at least one foreign agent and the at least one mobile node,

481. The at least one ghost-mobile node (local router R1 or agent) is a proxy element for the at least one foreign agent and the at least one mobile node.

482. For example, the local router R1 communicates advertisement messages to the mobile node on behalf of other local routers. *See* the analysis for element 1[g] above.

483. Likewise, the local router R1 acts as a proxy for the mobile node when it sends a Registration Request on the mobile nodes behalf. *See* the analysis for element 1[g] above.

[‘417, 4(b)] the at least one ghost-mobile node triggering registration based on a distance to a foreign agent by relaying security and shared secrets from a mobile node, and at least one advertisement message from a foreign agent in a vicinity of the ghost-mobile node.

484. In my opinion, the ’417 Patent fails to provide a written description of a system that “triggers registration … by ‘relaying’ shared secrets from a mobile node” to another node. That said, the ’417 Patent discloses a “shared key” in connection with the use the MD5 algorithm for security and authentication using a public key cryptosystem. *See* ‘417 Patent at 9:18-36. As an alternative, the ’417 Patent also discloses the use of an asymmetric authentication protocol such as 802.1X. *Id.* at 9:48-53.

485. To the extent these disclosures support this limitation, Gwon also discloses this limitation. As set forth above, the “ghost-mobile node” disclosed in Gwon I and Gwon II triggers

registration based on a distance to a foreign agent, and at least one advertisement message from a foreign agent in a vicinity of the ghost-mobile node. *See* the analysis for elements 1[f] and 1[g], above.

486. In addition, Gwon I and Gwon II disclose a process that triggers registration by relaying security and shared secrets from a mobile node during the registration process. For example, Gwon I states:

> Mobile node authentication and security processes are also performed to ensure the mobile node 135 is in fact legitimate and to avoid problems like eavesdropping, active replay attacks, and other types of attacks and unauthorized access to confidential data. Security and authentication measures are described in detail in the IETF Mobile IP version 6 draft document, which has been incorporated herein by reference. Others are described in IETF RFC 2401, 2402, and 2406, which are likewise incorporated herein by reference. The hand-off process and related authentication and security processes are described in detail in the proposed IETF Mobile IP standard documents previously identified and incorporated herein by reference, in IETF RFC 2462, which is also incorporated herein by reference, and in the other RFC's identified in this paragraph.

See, e.g., Gwon I at ¶ 54.

4. Analysis—Claim 7

[‘417, 7(a)] A method, in a mobile node, for speeding handover, comprising the steps of:

487. Gwon I discloses a method, in a mobile node, for speeding handover.

488. For example, Gwon I discloses:

> methods for predicting the mobility of mobile nodes in third generation and beyond wireless, mobile access Internet protocol-based data networks embodying IETF Mobile IP support, as well as in wireless LANs. Conventional Mobile IP mobility detection is replaced with deterministic, stochastic, and/or adaptive methods to predict the mobility of a mobile node in the network employing network logic layer (L3) packet latency characteristics. The method is useful for providing pre-notification that a communication hand-off condition is imminent to enable fast route pre-establishment and reduced packet latency, and for optimizing quality of service by

> facilitating selection of best base station transceiver in overlapping cell environments, among other applications.

Gwon I at Abstract.

489. Gwon I further states that:

> The present invention addresses both the packet latency and optimum network connection issues, among others, by providing methods for predicting mobile node mobility. Preferably, the methods of the invention will replace the current mobility detection methods of the proposed Mobile IP standards. Using the methods of the invention, the mobile node **135** is able to determine in advance when a network connection hand-off is imminent. Using this information, the mobile node can pre-establish a new network connection with a new router or agent, and pre-establish a new packet route with a correspondent node with which it is communicating, while retaining its previous network connection. Only when the new connection and route are established does the mobile node **135** sever its connection with the previous router or agent. This approach significantly decreases hand-off induced packet delays and loss. Moreover, using the information provided by the preferred prediction methods, the mobile node can select from among multiple available network connection nodes to optimize its network connection, thereby optimizing the quality of its network communications.

Id. at ¶ 55.

[‘417, 7(b)] updating, in a mobile node, a location in a ghost mobile node;

490. Gwon I discloses updating, in a mobile node, a location in a ghost mobile node, which the Court construed as meaning “updating the ghost mobile node with a location of the mobile node.”

491. As an initial matter, Gwon I discloses a “ghost mobile node” for the reasons discussed above for Claim Element 1(f).

492. Furthermore, Gwon I describes a predictive mobility scheme in which the location of a mobile node is continuously monitored and updated, performed by either the mobile node or

the base transceiver station (BTS). *See* Gwon at Abstract, ¶¶ 49-103 & Fig. 2. For example, Gwon I discloses:

> As the mobile node (MN) **135** moves from starting location A to intermediary location B, its movement is detected by one or more of a number of known mechanisms. Typically, the movement is detected in the media access control (MAC) portion of the mobile node's network link layer (L2) programming. Specific implementations vary but one known method includes the use of Down/Testing/Up interface status, as set forth in IETF RFC 1573, which is incorporated herein by reference. Another employs the detection of beacon signal strength. Another involves evaluation of the quality of the signals received by the mobile node **135.**

Id. at ¶ 50.

> In the preferred embodiment in the third generation network example being described, a mobility prediction analysis is periodically carried out with respect to a variable or characteristic related to mobility of the mobile node. The mobility prediction analysis is preferably carried out by the processor facilities of the mobile node 135 according to stored programming provided therein, such processor facilities and stored programming facilities being well-known. Alternatively, however, the mobility prediction can be performed in the processor facilities and stored programming of the mobile node’s local BTSS 145 and communicated to the mobile node the same as any other data in the network.

Id. at ¶ 56.

> The preferred mobility prediction analysis of the invention is generally sufficient by itself to accurately provide a threshold value to trigger desired actions by the mobile node. Nevertheless, if available, geographic mapping information such as that provided by GPS, may be used if available to supplement or confirm the results of the mobility prediction analysis.

Id. at ¶ 59.

> There are a number of potential ways to measure d. If a number of BTS cells are present such that the mobile node is receiving beacon signals from at least three BTS, conventional triangulation techniques based on relative beacon signal strength measurements can be used to determine the mobile node’s distance from each BTS. Another way is to use GPS.

Id. at ¶ 76.

[‘417, 7(c)] determining a distance, in the ghost mobile node in communication with the mobile node, to a closest foreign agent with which the mobile node can complete a handover;

493. Gwon I discloses determining a distance, in the ghost mobile node in communication with the mobile node, to a closest foreign agent with which the mobile node can complete a handover.

494. For example, Gwon I discloses that “[i]n the preferred embodiment in the third generation network example being described, a mobility prediction analysis is periodically carried out with respect to a variable or characteristic related to mobility of the mobile node.” Gwon I at ¶ 56.

495. Gwon I further discloses that this mobility prediction analysis can be carried out either in the mobile node or in the local router co-located or otherwise connected to a local base transceiver station (*i.e.*, “ghost mobile node”):

> The mobility prediction analysis is preferably carried out by the processor facilities of the mobile node 135 according to stored programming provided therein, such processor facilities and stored programming facilities being well-known. Alternatively, however, the mobility prediction can be performed in the processor facilities and stored programming of the mobile node’s local BTSS 145 and communicated to the mobile node the same as any other data in the network.

Id.; *see also id.* at ¶¶ 43-47 (“The mobile nodes communicate with the agents by way of base transceiver station servers (BTSS’s) and base transceiver stations (BTS’s)).” Gwon I further discloses that:

> Preferably, the mobility prediction analysis results in the determination of a threshold value, which is selected to indicate when a mobile node has sufficiently moved relative to a fixed BTS or other node that a desired action should be taken by the mobile node. For example, when the predicted value of the variable related to mobility exceeds a selected threshold value, the mobile node may

> initiate a new network connection and establish a new packet route with a correspondent node before actual hand-off is required. Alternatively or additionally, the mobility prediction analysis may be used to trigger pre-hand-off processing of authentication and security measures, to trigger advance handling of other aspects of the hand-off process itself, or to trigger selection of a new network connection to optimize the quality of the mobile node's connection and/or communications.

Id. at ¶ 57.

> Except d, which is the distance between the BTS and the mobile node, all of the parameters of Equation (8) are system parameters obtainable from either layer 2 or layer 3 programming of the mobile node. Thus, in the deterministic method, d is determined by measurement and is then applied to Equation (8) to solve for τ. There are a number of potential ways to measure d. If a number of BTS cells are present such that the mobile node is receiving beacon signals from at least three BTS', conventional triangulation techniques based on relative beacon signal strength measurements can be used to determine the mobile node's distance from each BTS. Another way is to use GPS.

Id. at ¶ 76.

496. I understand that Plaintiff's Infringement Contentions allege that the signal strength measurement reports from the mobile node contain events, such as Neighbor signal becoming better than a threshold, or a certain amount better than the signal of the node's current cell, and that these events indicate to the network that a mobile node will be moving into a new cell. Plaintiff explicitly points to Events A3 and A4 in the Measurement Reports. Plaintiff's Infringement Contentions fail to explain how these signal strength measurements constitute "determining a distance … to a closest foreign agent." In my opinion, signal strength measurements do not constitute determining a distance; they are simply measurements of actual signal strengths for various cells at specified times. Nevertheless, if this infringement analysis is proper for this limitation, then Gwon I also discloses this limitation under Plaintiff's interpretation.

497. For example, Gwon I discloses:

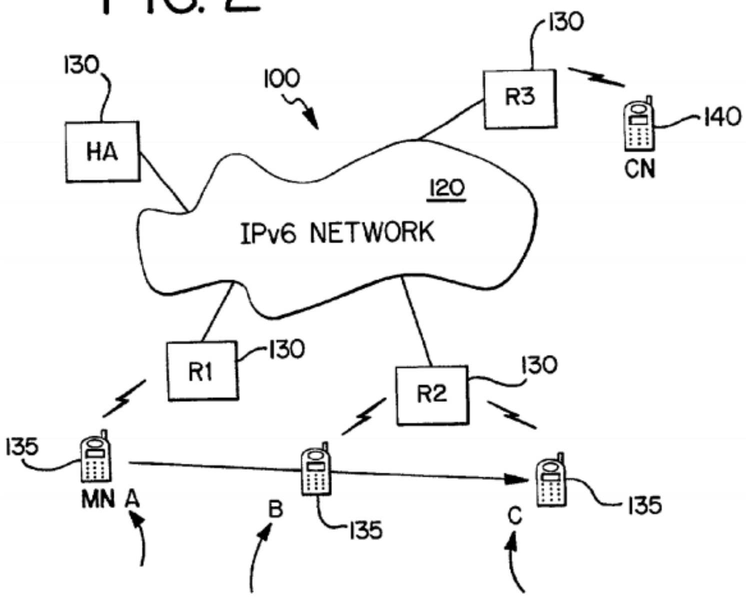
> The mobility prediction analysis is preferably carried out in the network layer 3 logical addressing and routing programming of the mobile node **135** or BTSS **145** with respect to an L3 variable related to mobility. ***A known conventional method for determining a handoff timing uses beacon strength measured in Layer 2 or the mobility access control (MAC) layer***. Under this method, the mobile node **135** constantly monitors and evaluates signal strengths of beacon signals from the current BTS **150** and nearby BTS's **150** and carries out a handoff to a new BTS **150** that is transmitting the strongest beacon signal. Similarly, evaluation of connection to a current BTSS **145** and connectivity to nearby BTSS's **145** is carried out in the network layer 3 through exchanges of packets between the mobile node **135** and the BTSS's **145** as already described above. For instance, routers voluntarily transmit advertisement packets to advertise their presences to mobile nodes passing by. The advertisement packet may be considered a Layer 3 beacon analogous to a Layer 2 beacon for strength measurement. The mobility prediction analysis according to the present invention is carried out in the network layer 3, using these special packets. However, known network layer 2 methods such as beacon strength measurements carried out in the lower level layers may be used to supplement or confirm the layer 3 predictive results. Moreover, the predictive methods of the invention may also be applied to layer 2 variables related to mobility to achieve similar results.

Id. at ¶ 58 (emphasis added).

[‘417, 7(d)] submitting on behalf of the mobile node, from the ghost mobile node, a registration to the foreign agent to which the mobile node is going to complete the handover; and

498. Gwon I and Gwon II, alone or in combination, disclose submitting on behalf of the mobile node, from the ghost mobile node, a registration to the foreign agent to which the mobile node is going to complete the handover.

FIG. 2

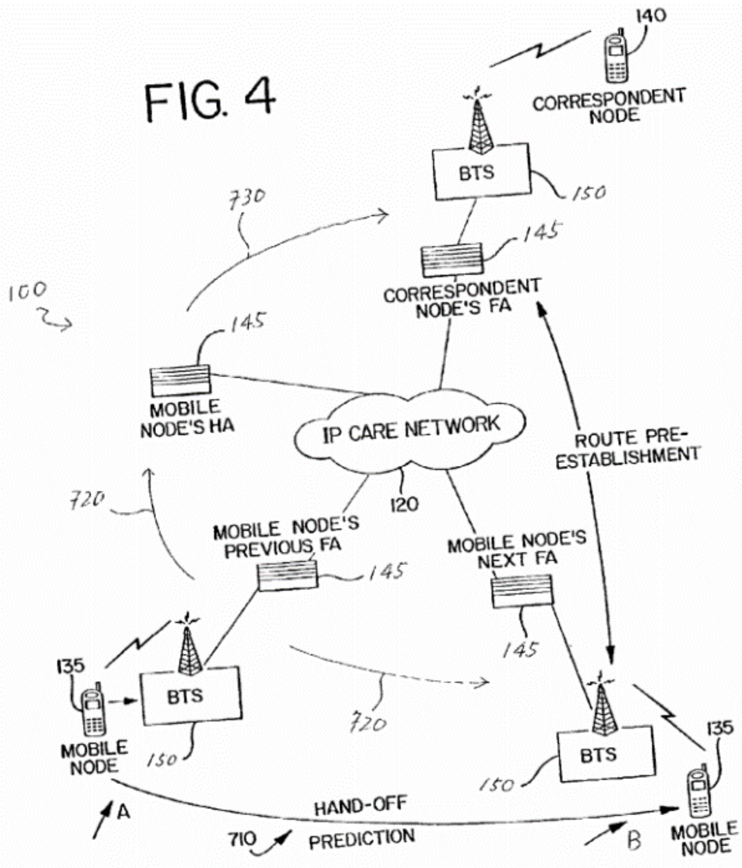


499. As illustrated in Figure 2 of Gwon I, a mobile node (MN) that is currently connected to local router R1 (*i.e.*, "ghost mobile node") "will have identified new local router R2 with which to establish its new network connection." Gwon I at ¶ 53 & Fig. 2. "Once the new local router R2 is identified, the mobile node 135 hands-off its network connection from the prior router R1 to the new router R2 by registering with the new router R2 and de-registering with the prior router R1." *Id.* at ¶ 54. The mobile node registers while still connected to local router R1, which forwards the registration request on behalf of the mobile node. *See id.* at ¶ 55 ("[T]he mobile node is able to determine in advance when a network connection hand-off is imminent … [T]he mobile node can pre-establish a new network connection with a new router or agent, and pre-establish a new packet route with a correspondent note with which it is communicating, while retaining its previous network connection.").

500. Gwon II, which incorporates Gwon I by reference, further discloses a method of handover in which a mobile node or a its local agent (*i.e.*, "ghost mobile node") carries out a mobility prediction analysis "to determine when it is imminent that the mobile node in

communication with a correspondent node must hand-off its network communications link from a current foreign agent (FA) to another foreign agent as it moves from a location A to a location B in the network," as illustrated in Figure 4 below. *See* Gwon II at ¶ 59 & Fig. 4; *see also id.* at ¶¶ 60-61, 74.

FIG. 4



501. Gwon II further discloses that, once the mobile node has obtained the information necessary to communicate with the next foreign agent, it undertakes a pre-registration process in which the mobile node sends a registration request to its current foreign agent (*i.e.*, "ghost mobile node"), which in turn forwards the registration request to the next foreign agent to which the mobile node is going to handover:

> Once the mobile node **135** has obtained the information necessary to communicate with the next foreign agent **145**, it undertakes a pre-registration process **720** with the mobile node's home agent

> (HA) **145**. If necessary, the pre-registration process **720** is also carried out with a gateway router in the domain to which the next foreign agent **145** belongs. The pre-registration process **720** is the same process the mobile node **135**would otherwise follow to register with a new foreign agent **145** during the hand-off procedure as specified in the Mobile IP version 4 and version 6 documents. Thus, the mobile node prepares and sends a Registration Request to the next foreign agent **145**. If the Layer 2 communication channel is already established, the Registration Request is directly sent from the mobile node **135** to the next agent **145**. ***If the Layer 2 communication channel is not yet established, the Registration Request is sent to the next foreign agent 145 through the current foreign agent 145***.

Id. at ¶ 76 (emphasis added).

[‘417, 7(e)] upon completing the handover, updating a registration in the mobile node.

502. It is my understanding that Plaintiff alleges that in the accused LTE network the target eNB updates a registration in the mobile node by providing uplink allocation and timing advance information to the UE, thereby satisfying this limitation. In my opinion, Plaintiff’s allegations do not make sense because *inter alia* in the accused LTE network registration must occur before handover is complete. Nevertheless, if Plaintiff’s infringement analysis is proper for this limitation, then Gwon I and Gwon II, alone or in combination, disclose this limitation.

503. For example, Gwon I discloses that when a mobile node hands-off its network connection from the prior local router R1 to the new router R2, it registers with the new router and de-registers with the prior router. Gwon I at ¶ 54. As part of the registration process:

> As part of the registration/de-registration process, the mobile node or new router R**2** provides binding updates, i.e., sends a new “care of” IP address, to the mobile node's home router and to the correspondent node with which the mobile node is communicating. This enables packets to be routed to and from the mobile node via the new router R**2** instead of the prior router R**1**. Mobile node authentication and security processes are also performed to ensure the mobile node **135** is in fact legitimate and to avoid problems like eavesdropping, active replay attacks, and other types of attacks and unauthorized access to confidential data.

Id. "Only when the new connection and route are established does the mobile node sever its connection with the previous router or agent." *Id.* at ¶ 55.

504. Gwon II likewise discloses a method of handover in which "[c]ommunications between the mobile node and the new neighboring node are pre-established and a new route between the mobile node and its correspondent node is pre-established. Upon hand-off, the pre-established route is ready to implement." Gwon II at ¶ 27.

505. Once the mobile node has obtained the information necessary to communicate with the next foreign agent, it undertakes a pre-registration process in which the mobile node sends a registration request to its current foreign agent (*i.e.*, "ghost mobile node"), which in turn forwards the registration request to the next foreign agent to which the mobile node is going to handover. *Id.* at ¶ 76. The registration request includes a request for the mobile node's new "care-of" IP address through the next foreign agent. *Id.* at ¶ 76. In response:

> The next foreign agent **145** communicates the Registration Request, along with the mobile node's new care of address, to the mobile node's home agent **145**. If the home agent **145** approves the Registration Request, it sends a Registration Reply to the mobile node **135** via the current foreign agent or next foreign agent **145**. This process acts as an acknowledgement (ACK) of the success of the pre-registration process.

Id.

> The Registration Request requests the home agent **145** to update its binding cache to bind the mobile node's new care-of IP address to its home IP address. The Registration Request also requests the home agent **145** to notify the correspondent node **140** of the new binding information so that it also can update its binding for the mobile node…. [O]nce a Registration Request, including a Binding Update Request, is processed and a Registration Reply including Binding Acknowledgement sent and received, the mobile node **135** is essentially ready to switch from the current foreign agent to the next foreign agent.

Id. at ¶ 79. "[O]nce the Binding Update Acknowledgement is received, the mobile node switches or hands-off its communication link with the network from the current foreign agent to the next foreign agent." *Id.* at ¶ 83.

XI. CLAIMS 1, 3, AND 4 OF THE '330 PATENT ARE INVALIDATED BY THE PRIOR ART

A. Mount Anticipates the Asserted Claims or Renders Them Obvious in View of NIST

1. Mount

506. Mount, U.S. Patent No. 6,272,337, issued on August 7, 2001, from an application filed on May 17, 1999. It therefore qualifies as prior art under 35 U.S.C. §§ 102(a), (b), and (e) (pre-AIA). Mount was not cited or considered during the prosecution of the '330 Patent.

507. The Abstract of Mount provides:

> A method and apparatus testing a mobile communications system includes a test control system, real mobile units, and an attenuator matrix controllable by the test control system to vary strengths of signals transmitted by the mobile units for receipt by the mobile communications system. By varying the attenuation of the signals communicated between the mobile units and the mobile communications system, the mobile units may be made to appear to be moving to the mobile communications system. Movement patterns of the mobile units may be stored in the test control system to control attenuation in the attenuator matrix.

Mount at Abstract.

508. Mount and the '330 Patent similarly seek to address the problem of emulating movement of a mobile node in a wireless communication network:

> SUMMARY
>
> In general, according to one embodiment, a simulation system for testing a mobile communications system includes a controller and a plurality of mobile units. A signal processing device is controllable by the controller to vary strengths of signals transmitted by the mobile units for receipt by the mobile communications system to simulate movement of the mobile units.

> Some embodiments of the invention may include one or more of the following advantages. Varying strengths of transmitted signals of mobile units to simulate their movement allows greater flexibility in testing mobile communications systems. It may be possible to test a larger number of mobile units and to provide more movement patterns of the mobile units. Costs associated with testing may be reduced since simulation of mobile unit movement removes the need for having to actually physically move mobile units along desired paths during testing. Greater accuracy in test results may also be obtained by increasing the number of mobile units and movement patterns in a test of a mobile communications system.

Id. at 1:55-2:7; *see also, e.g.*, ’330 Patent at 2:19-32, 2:59-3:3, 3:9-21, 3:27-38.

Mount discloses a number of cells 18 each having a base transceiver station 28, real mobile units 14, a traffic generator (TG) task 120, an air emulation system (AES) task 114, and an attenuator matrix 16, as shown in Figures 1A and 2, reproduced below.

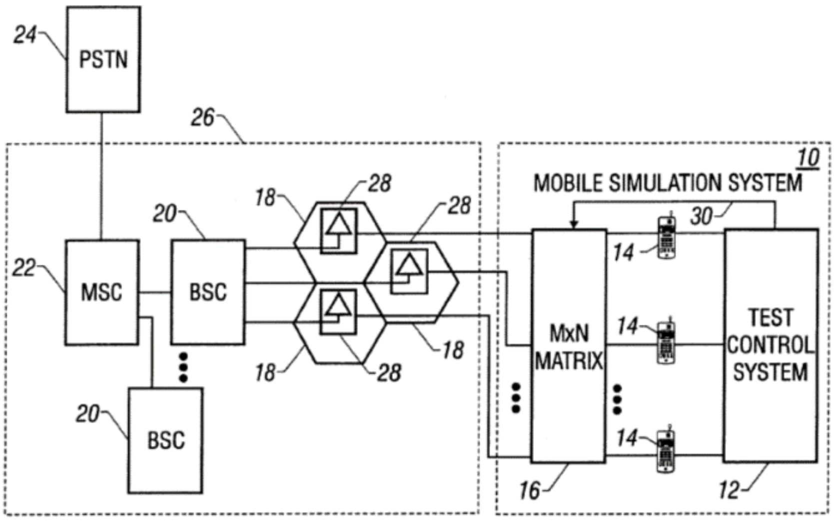


FIG. 1A

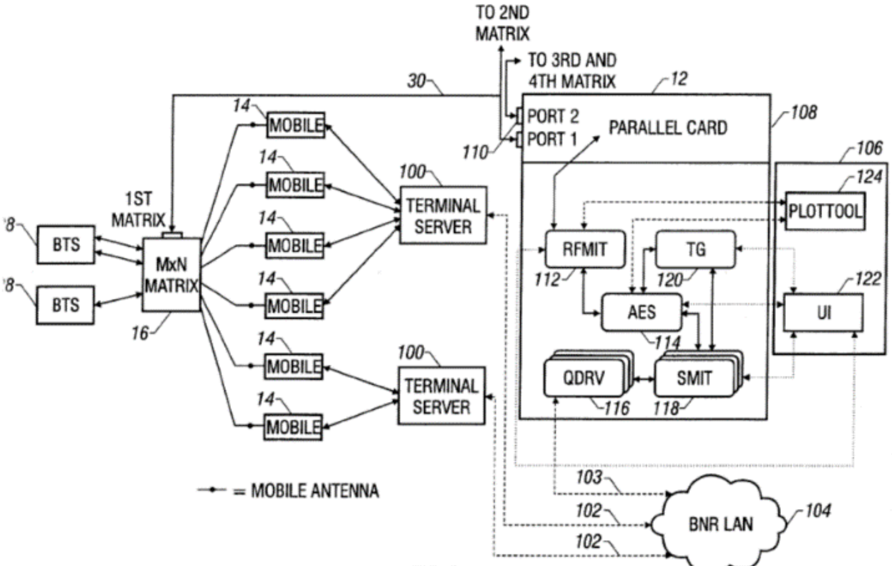


FIG. 2

Mount at Figs. 1A and 2.

2. <u>NIST Net</u>

509. "NIST Net – A Linux-based Network Emulation Tool," by Mark Carson and Darrin Santay published July 2003. It therefore qualifies as prior art under 35 U.S.C. § 102(a) (pre-AIA).

510. The Abstract of NIST Net provides that it is "a tool to facilitate testing and experimentation with network code through emulation. NIST Net enables experimenters to model and effect arbitrary performance dynamics (packet delay, jitter, bandwidth limitations, congestion, packet loss and duplication) on live IP packets passing through a commodity Linux-based PC router." NIST Net at Abstract.

511. NIST Net discloses that "[a] useful way to think of NIST Net is as a 'network-in-a-box' (Figure 1) — a specialized router which emulates (statistically) the behavior of an entire network in a single hop. NIST Net selectively applies network effects (such as delay, loss, jitter) to traffic passing through it, based on user-supplied settings." NIST Net at 112.

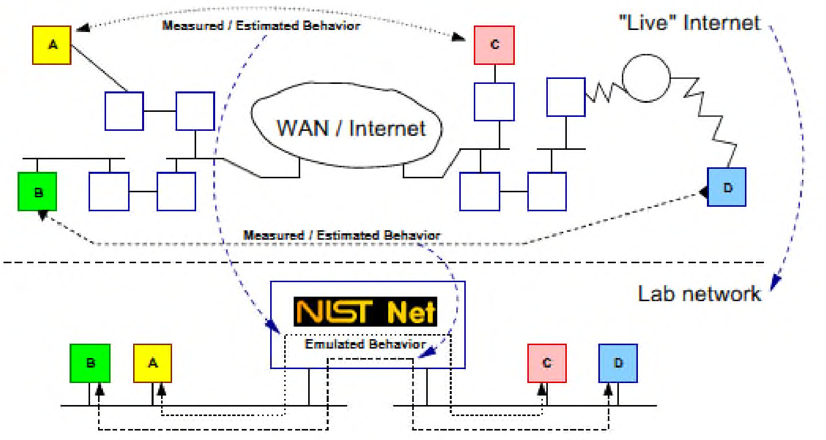


Figure 1: NIST Net as a "network in a box"

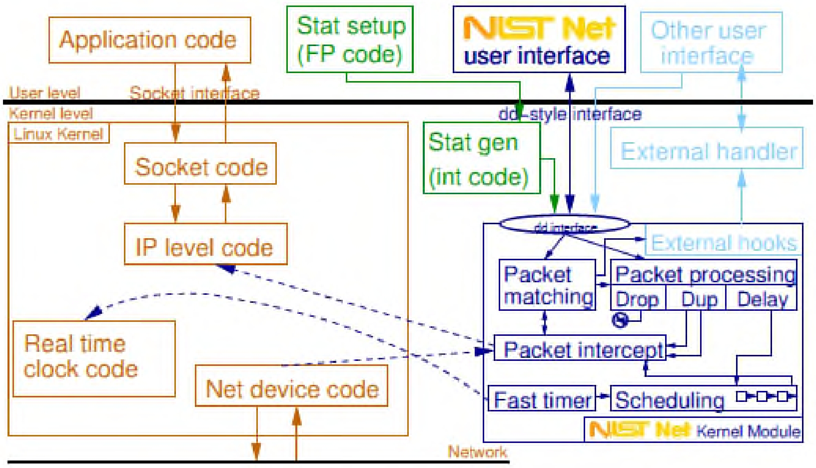


Figure 2: NIST Net Architecture

512. The graphical user interface of NIST Net shown in Figure 3 shows the ability to tune delay, bandwidth, packet drop, and packet duplication, for example.

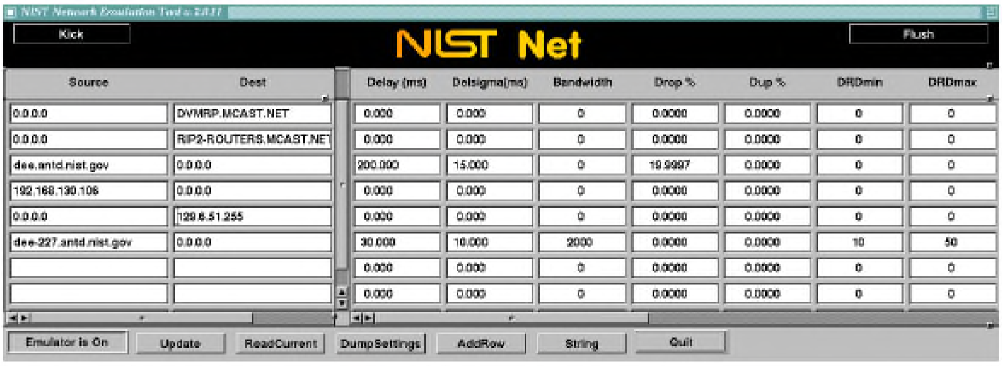


Figure 3: NIST Net graphical user interface

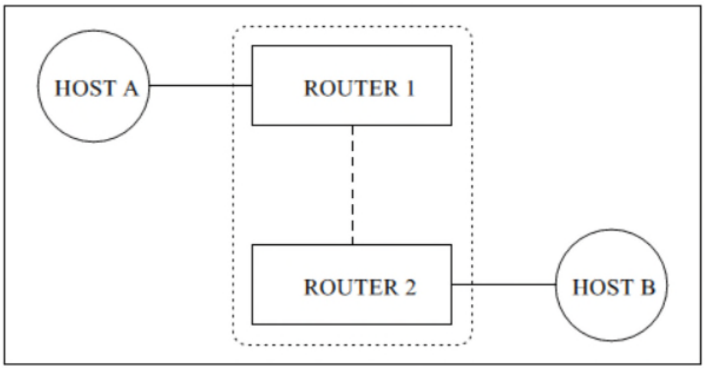
NIST Net at Figure 3.

3. <u>ONE</u>

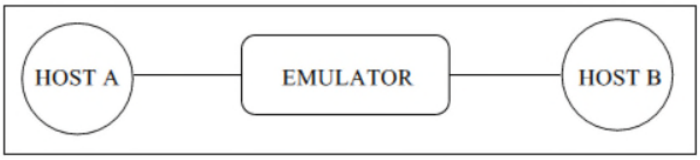
513. "ONE: The Ohio Network Emulator," by Mark Allman, Adam Caldwell, and Shawn Ostermann, published August 18, 1997. It therefore qualifies as prior art under 35 U.S.C. §§ 102(a) and (b) (pre-AIA).

514. The Abstract of ONE provides that "[s]tudying network protocols and distributed applications in real networks can be difficult due to the need for complex topologies, hard to find physical channels (e.g., satellite channels), and conditions beyond the control of a researcher (e.g., queue sizes). Network emulators can provide a controlled and reproducible environment for network testing. This paper discusses *ONE*, a network emulator we have written and tested" ONE at Abstract.

515. The '330 Patent discloses that "[t]he Ohio Network Emulator (ONE) . . . is able to emulate transmission, queuing, and propagation delay between two computers connected by a router." '330 Patent at 2:2-8. ONE emulates a network topology as seen in Figure 1 and its emulated network topology is shown below in Figure 2.



ONE at Figure 1.



ONE at Figure 2.

ONE explains that it "models the routers and intervening network by delaying packets arriving on one network interface before forwarding them to the other network. *ONE* also provides congestion loss according to its configuration. The delay a packet experiences is based on the packet size and the configuration parameters given by the user." ONE at 2.

4. <u>Analysis—Claim 1</u>

['330, 1(a)] A system for emulating mobile network communications comprising:

516. Mount discloses "[a] system for emulating mobile network communications." For example, the Abstract of Mount provides that it discloses "[a] method and apparatus testing a mobile communications system includ[ing] a test control system, real mobile units, and an attenuator matrix controllable by the test control system to vary strengths of signals transmitted by the mobile units for receipt by the mobile communications system." Mount at Abstract. Mount goes on to explain that the motivation for the invention includes that "[d]uring development of components (both hardware and software) of mobile switching centers in a mobile

communications system, various types of tests may be performed to determine whether the components are operating properly. Such tests may be performed using software simulation of certain parts of a mobile communications system, which may include software emulation of mobile units and base stations." Mount at 1:29-36.

517. Mount goes on to explain that in one embodiment of the invention, there is such "a simulation system for testing a mobile communications system" which "includes a controller and a plurality of mobile units." That "mobile communications system" may comprise, for example, cellular and personal communications services (PCS) systems, among other types of wireless communications systems. Mount at 2:45-41. As Mount explains, "[t]hus, a mobile simulation system has been disclosed that includes real mobile units that are controllable by the mobile simulation system to access, and communicate in, a mobile communications system that is under test." Mount at 9:3-6; *see also* Cls. 1, 14, 24. Such a mobile simulation system is shown below as disclosed in Figures 1A and 2.

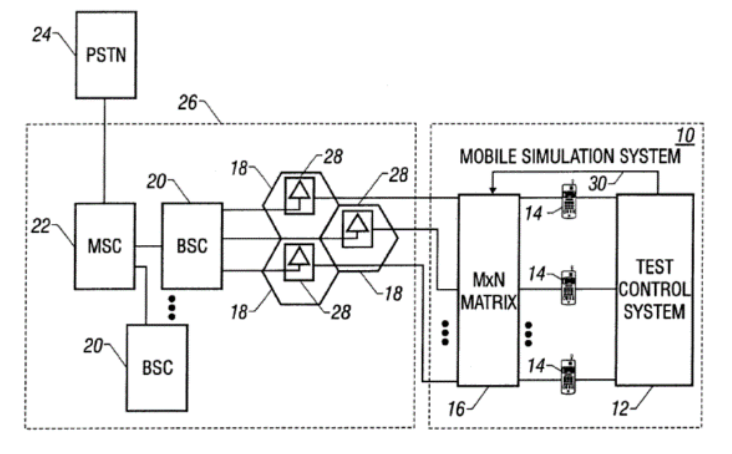


FIG. 1A

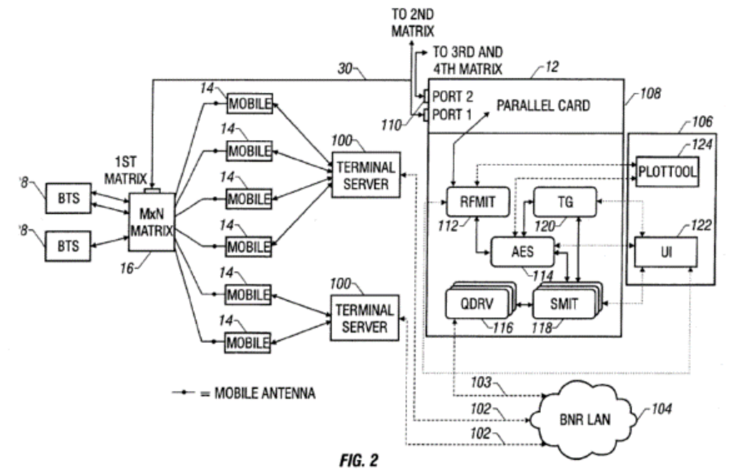


FIG. 2

[‘330, 1(b)] a plurality of fixedly-located wireless network nodes configured to variably adjust wireless communication characteristics;

518. Mount discloses “a plurality of fixedly-located wireless network nodes configured to variably adjust wireless communication characteristics.” The parties agreed that the term “fixedly-located” means “set at a particular location,” and “wireless network nodes” means “an element of a network that sends and receives signals wirelessly.” The Court construed the term “configured to variably adjust wireless communication characteristics” as “configured such that

the controller can cause the wireless network nodes to adjust wireless communication characteristics of the wireless network nodes."

519. For example, with reference to Figure 1A above, Mount discloses "a number of cells 18 each having a base transceiver station 28." Mount at 2:52-67. A POSITA would have known that these base transceiver stations 28 would have been fixedly located such that they were set at a particular location. For example, Mount states that "[d]uring initialization, the user interface task 122 provides the number of cells, placement and location of cells, and cell types to the AES task 114." Mount at 8:9-12. The base transceiver stations 28 "may include a relatively low-power, multichannel radio transceiver adapted to communicate with mobile units within a cell by radio frequency (RF) or other types of wireless signals," Mount at 2:52-67, and thus, the base transceiver stations 28 "send[] and receive signals wirelessly."

520. Finally, the base transceiver stations 28 of Mount are "configured to variably adjust wireless communication characteristics" such that they are "configured such that the controller can cause the wireless network nodes to adjust wireless communication characteristics of the wireless network nodes." The base station transceiver stations are coupled to a base system controller (BSC) 20, which in turn may be coupled to a mobile switching center 26 (MSC). Mount at 2:52-67. Both the mobile units 14 and the base transceiver stations are coupled to an attenuator matrix 16, which may be configured as an MxN matrix of attenuators, where M corresponds to the number of base transceiver stations and N corresponds to the number of mobile units. Mount at 3:29-40. It is through this attenuator matrix 16 that the base transceiver stations, BSCs, and MSCs adjust the attenuation and wireless communication characteristics and "the MSC **22** senses the mobile units **14** as moving when in fact they may be stationary. Thus, with the attenuator matrix **16**, apparent movement patterns of the mobile units **14** can be controlled by the mobile simulation

system **10**." Mount at 4:6-14. Mount discloses that "[i]n other embodiments, devices other than attenuators may be used to vary strengths of signals transmitted by the mobile units **14**. For example, instead of the attenuator matrix **16**, another type of signal processing device, which may include amplifiers, attenuators, filters, or other types of circuits, may be coupled to the mobile units." Mount at 3:64-4:6.

['330, 1(c)] at least one mobile node configured to wirelessly communicate with selected ones of said plurality of wireless network nodes;

521. Mount discloses "at least one mobile node configured to wirelessly communicate with selected ones of said plurality of wireless network nodes." The parties agreed that the term "mobile node configured to wirelessly communicate" means "a device that sends and receives signals wirelessly," and "wireless network nodes" means "an element of a network that sends and receives signals wirelessly.

522. For example, with reference to Figure 1A above, Mount discloses that "the mobile simulation system **10** includes actual or real mobile units **14** (e.g., mobile telephones or other mobile communications units) that are capable of requesting access to, and communicating in, the mobile communications system **26**." These "real mobile units **14** provide the interface from the mobile simulation system **10** into the mobile communications system **26**." Mount at 3:14-23.

523. As explained above with respect to the wireless network nodes, "[e]ach base transceiver station **28** may include a relatively low-power, multichannel radio transceiver adapted to communicate with mobile units within a cell by radio frequency (RF) or other types of wireless signals." Mount at 2:55-59. Because the base transceiver stations 28 communicate "by radio frequency (RF) or other types of wireless signals," the mobile nodes are configured to communicate wirelessly with selected ones of the wireless network nodes.

524. This is further illustrated in Figure 2, which "is a block diagram of the mobile simulation system of Fig. 1A according to one embodiment of the invention." Mount at 2:18-19. Here, it can be seen that the mobile units 14 are connected to the MxN attenuator matrix 16 via "mobile antennas."

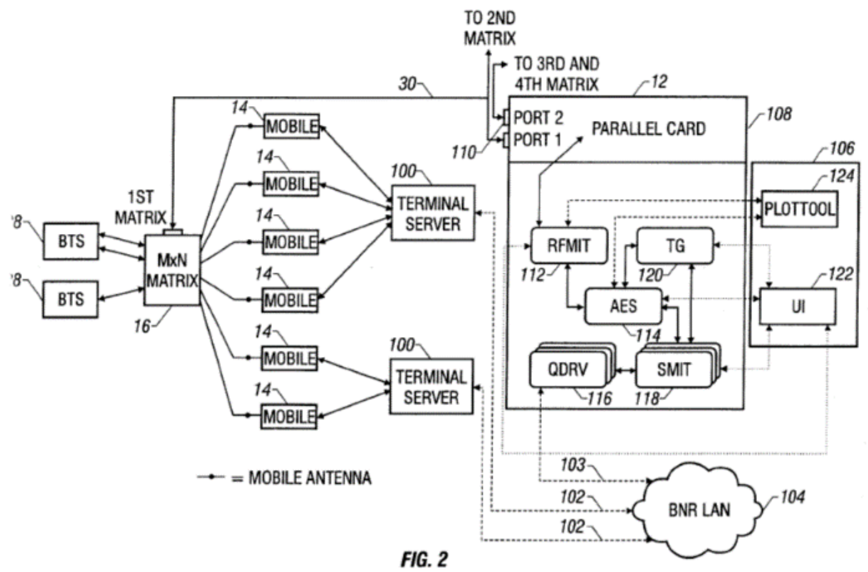


FIG. 2

525. Figure 4 similarly supports that the mobile units 14 communicate wirelessly, where it shows the mobile antenna of the mobile unit in contrast to the "speaker wire" and "microphone wire."

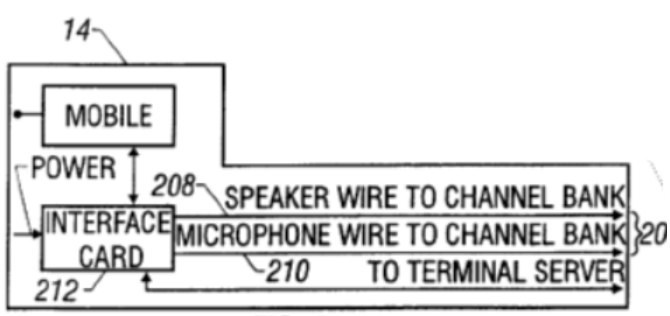


FIG. 4

526. Similarly, Figure 1B shows that the mobile units 14 communicate with the base transceiver stations wirelessly via antennas. Figure 1B is shown below.

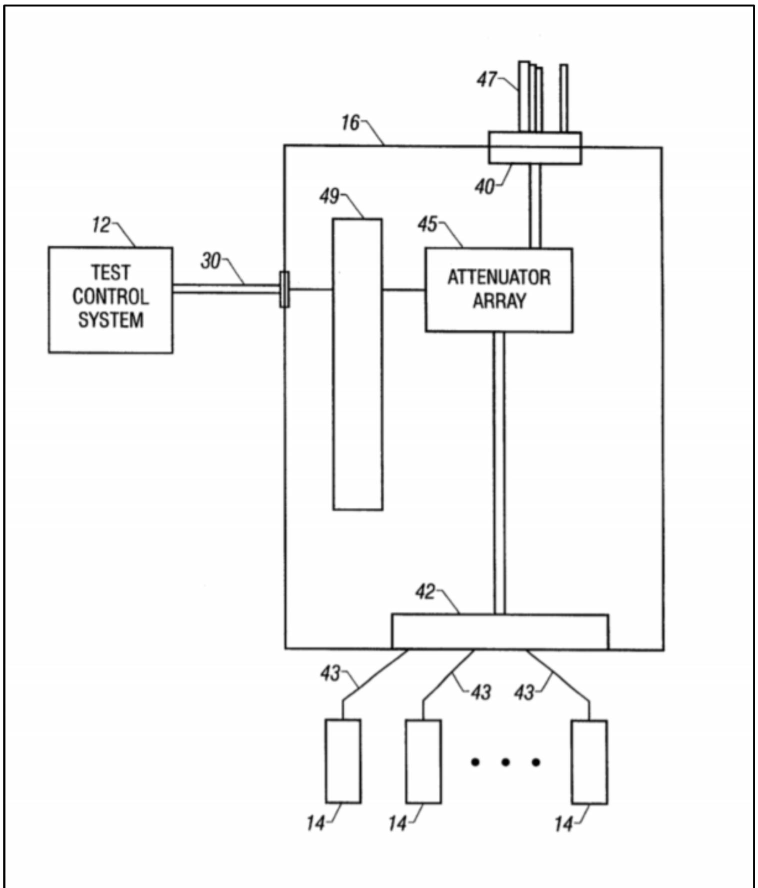


FIG. 1B

527. In Figure 1B, the mobile units **14** are coupled to the attenuator matrix 16 via wired links 43, and then "[t]he other side of the attenuator array **45** is coupled to a second set of cell ports **40**, which are connected to antennas **47** for wireless communications with base transceiver stations **28**." Mount at 3:41-63. It is my opinion that Mount satisfies the limitation of the mobile units communicating wirelessly with the wireless network nodes, as the connection in certain embodiments of Mount is wireless, as described above. However, even in the embodiment of Figure 1B, it is my opinion that the mobile units communicate wirelessly with the base transceiver stations as the eventual connection between the mobile units and the base transceiver stations is

over an antenna, even though the connection between the mobile units and the attenuator matrix 16 may, in some cases, be wired. To the extent that Mobility argues that Mount does not disclose this limitation, it is my opinion that it would have been obvious to a person of ordinary skill in the art to adapt Mount to use a wireless connection.

528. I have reviewed Mobility's infringement contentions, and I understand that Mobility may contend that a wired connection between the mobile nodes and the wireless network nodes infringes claim 1 of the '330 Patent. For the reasons described above, it is my opinion that Mount anticipates and/or renders obvious claim 1 under Mobility's infringement theory as well..

['330, 1(d)] a network emulator communicatively linked to each of said plurality of wireless network nodes, said network emulator configured to emulate attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network, the emulated attributes comprising at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication; and

529. Mount discloses "a network emulator communicatively linked to each of said plurality of wireless network nodes, said network emulator configured to emulate attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network, the emulated attributes comprising at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication." The parties agreed that the term "wireless network nodes" means "an element of a network that sends and receives signals wirelessly," and the term "a packet-based wired communications network" means "a communications network in which packets of data are transmitted through wires or cables." The Court construed the term "communicatively linked" to mean "capable of transmitting and receiving signals via an interface."

530. First, it is my opinion that Mount discloses a network emulator. For example, within the test control system 12 in Figure 1A above, Mount discloses a "traffic generator (TG) task 120" that "'simulates' a mobile a mobile subscriber by directing a mobile unit **14** to make and answer calls. Calls may be made according to test case scenarios provided by a user, which may describe a traffic environment for testing. During traffic testing, the TG task **120** issues instructions to step through normal stages of call setup, conversation, and call termination, according to test cases provided to the TG task **120**." Mount at 6:1-8. Mount discloses that:

> After initialization, traffic may be started. As illustrated in FIG. 8, this may be started by the user interface task **122** issuing a Start_Traffic message to the TG task **120**. In response, the TG task can then send a Start_Move message to the AES task **114** to request that the AES task **114** start the movement of mobile units **14**. Depending on test cases entered by one or more operators, the TG task **120** may also issue various operations to be performed by the mobile units **14** by sending corresponding messages to SMITs **118**. In one embodiment, one SMIT **118** may be provided for each mobile unit **14**. For example, such messages may include the following: Originate_Call (to originate a call through the MSC **22**); Answer_Call (to answer an incoming call, either from another mobile unit **14** or from some other source); and Tone_Send (to send a tone, such as that associated with pressing of a numeric key on the mobile unit **14**).

Mount at 8:15-46.

531. Moreover, also within the test control system 12, Mount discloses an "air emulation system (AES) task **114**." "The AES task **114** primarily manages movement of the mobile units **14** to control positions of the mobile units **14**. Thus, the AES task **114** can control moving mobile units **14** along directed paths at varying speeds, for example. In addition, the AES task **114** is able to emulate the air environment, including emulation of physical obstructions such as buildings and other structures." Mount at 6:9-17. Mount further states:

> The AES task **114** also provides messages containing connection information to the SMITs **118** in the test control system **12**. Connection information may include the cell and sector that each

> mobile unit **14** is located in, services available, and so forth. The SMITs **118** transmit command messages to the mobile units **14** through respective QDRV tasks **116**. The SMITs **118**, in addition to the command messages, may also send vendor serial numbers of the mobile units **14**. Such serial numbers may be dynamically assigned to the mobile units **14** so that different types of services may be associated with the mobile units (e.g., analog, digital, and so forth). Additionally, the serial number may be assigned so that a mobile unit **14** may be one identified to be roaming in the mobile communication system under test.

Mount at 8:15-46.

532. Next, Mount discloses that this network emulator is communicatively linked to each of said plurality of wireless network nodes. For example, Mount discloses that, as seen in Figure 2 above, "[a] parallel card 108 in the test control system 12 may provide ports that connect to one or more control lines 30 to the attenuator matrix 16." Mount at 5:16-19. And as explained above regarding Element 1(b), the attenuator matrix 16 is communicatively linked to the base transceiver stations or wireless network nodes.

533. Furthermore, Mount discloses that the network emulator is configured to emulate attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network, the emulated attributes comprising at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication. As described above, the TG task 120 "simulates a mobile subscriber by directing a mobile unit **14** to make and answer calls. Calls may be made according to test case scenarios provided by a user, which may describe a traffic environment for testing." Mount at 6:1-8. Similarly, Mount discloses an AES task 114 that "primarily manages movement of the mobile units **14** to control positions of the mobile units **14**. Thus, the AES task **114** can control moving mobile units **14** along directed paths at varying speeds, for example. In addition, the AES task **114** is able to emulate the air

environment, including emulation of physical obstructions such as buildings and other structures." Mount at 6:9-17. Further, Mount discloses that its system simulates congestion by "increasing the number of mobile units 14 in the mobile simulation system 10, [whereby] the performance threshold of the mobile communications systems 26 (including the MSC 22 and BSC 20) can be tested, including its ability to handle large number of access requests and maximum capacity for concurrent calls." Mount at 4:63-5:1. A POSITA would have understood that this simulation is "packet-based," as Mount discloses that it simulates a CDMA or TDMA network, both of which are packet-based. Mount at 3:52-55.

534. A POSITA would have known that emulating calls, a traffic environment, movement of the mobile units at varying speeds, and emulation of the air environment, including emulation of physical obstructions such as buildings and other structures are all attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network. Further, a POSITA would have known that this emulation comprises at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication. A POSITA would have known, and it is my opinion, that emulation of calls, a traffic environment, and movement of the mobile units at varying speeds would comprise emulation of at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication. For example, "a traffic environment" necessarily involves emulation of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication simply by the very nature of emulating traffic. If multiple packets are being passed across the network as traffic, there will necessarily be a limitation on bandwidth, for example.

535. To the extent that Mobility contends that Mount does not disclose any portion of this limitation, it would have been obvious to a person of ordinary skill in the art at the time of the alleged invention to adapt the disclosures in Mount to include this limitation. Moreover, it would have been obvious to a person of ordinary skill in the art to combine the teachings of Mount with the teachings of NIST Net, for the reasons explained more fully below.

536. A POSITA would have been motivated to modify Mount to include the teachings and emulator of NIST Net because both of these references relate to systems for emulating mobile communications networks. Both Mount and NIST Net disclose known and interchangeable uses of an emulator equipment, and a POSITA would have understood that combining a known prior art emulator, disclosed in NIST Net, with the simulation system of Mount would yield predictable and beneficial results.

537. Similarly, the ’330 Patent itself discusses the NIST Net emulator and provides it as an example of an optimal emulator for satisfying limitation **[‘330, 1(d)]**.’330 Patent at 5:60-6:2 (“For example, the emulator 110 can be implemented using a computer system executing the National Institute of Standards and Technology (NIST) emulator.”).

538. A POSITA would have understood that Mount and NIST Net would have been easily combinable. For example, NIST Net explains that it allows “*external* hooks into its module as well. External statistics generation code may supply values for NIST Net's generation of network effects. . . . Alternatively, *external handlers* may work in concert with NIST Net or take over packet processing entirely.” NIST Net at 115-116. Thus, a POSITA would have understood that it would have been easy to adapt the emulator of NIST Net to work in the system of Mount.

539. Moreover, NIST Net explains that it was easily and widely accessible as “[t]housands of people throughout the world ha[d] successfully installed and used the emulator for

a wide variety of projects, even those with no prior experience with Linux. It has proven particularly useful in academic settings for class laboratories and student research projects." NIST Net at 112. In particular, NIST Net explains that in 2003, "[s]ince its initial release, NIST Net ha[d] been obtained by nearly twenty thousand people around the world, and has been used for a wide variety of testing purposes, including for voice over IP, mobile network emulation, adaptive video transmissions, satellite and underseas radio link emulation, and interactive network gaming." NIST Net at 125. Further, NIST Net explains that its code, documentation, and calibration results "are all public domain and are available through its web site." NIST Net at 125.

540. Because the NIST Net emulator was a well-known, easily-accessible, and easily-adaptable emulator at the time, as evidenced at least by the '330 Patent itself and the evidence explained in NIST Net, it is my opinion that a POSITA would have found it obvious to combine the method and apparatus for testing a mobile communications system of Mount with the emulator of NIST Net.

541. As disclosed in the '330 Patent itself and as disclosed in NIST Net, the NIST Net emulator is "a tool to facilitate testing and experimentation with network code through emulation. NIST Net enables experimenters to model and effect arbitrary performance dynamics (packet delay, jitter, bandwidth limitations, congestion, packet loss and duplication) on live IP packets passing through a commodity Linux-based PC router." NIST Net at Abstract; *see also* '330 Patent at 5:60-6:2.

542. NIST Net similarly explains that "it provides the ability to emulate common network effects such as packet loss, duplication or delay; router congestion; and bandwidth limitations. It is designed to offer sufficient capabilities and performance to reproduce a wide range of network behaviors (forwarding rates of up to 1 Gbps, satellite-like delays or longer, asymmetric

characteristics), while requiring only commodity PC hardware and operating systems." NIST Net at 111.

543. NIST Net explains that "[a] useful way to think of NIST Net is as a "network-in-a-box" (Figure 1) — a specialized router which emulates (statistically) the behavior of an entire network in a single hop. NIST Net selectively applies network effects (such as delay, loss, jitter) to traffic passing through it, based on user-supplied settings." NIST Net at 112. Specifically, the "set of network effects NIST Net can impose includes: packet delay, both fixed and variable (jitter); packet reordering; packet loss, both random and congestion-dependent; packet duplication; and bandwidth limitations." NIST Net at 112. NIST Net goes on to explain in detail how its packet delay, packet loss, packet duplication, packet reordering, congestion, and bandwidth limitations are calculated. NIST Net at 113-114, 118-119, 123-124.

544. The NIST Net graphical user interface showing the ability to adjust these various parameters is shown at Figure 3 below.

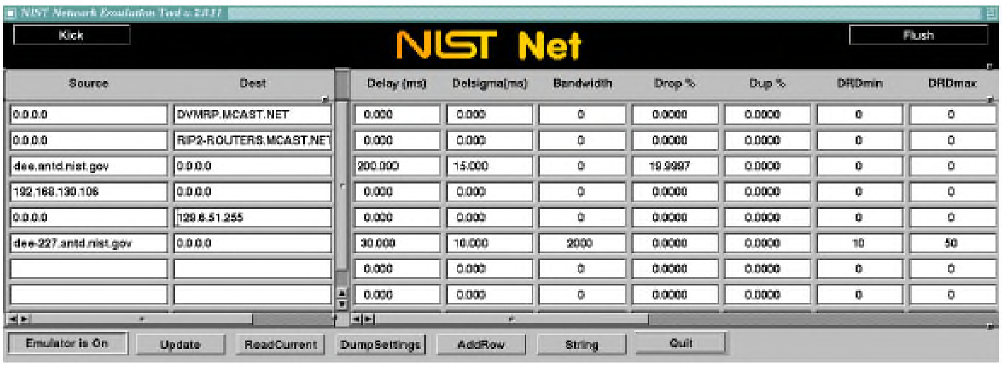


Figure 3: NIST Net graphical user interface

545. Thus, NIST Net discloses emulating attributes of a packet-based wired communications network including at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication.

546. To the extent that Mobility contends that Mount does not disclose any portion of this limitation, it would have been obvious to a person of ordinary skill in the art at the time of the alleged invention to adapt the disclosures in Mount to include this limitation. Moreover, it would have been obvious to a person of ordinary skill in the art to combine the teachings of Mount with the teachings of ONE, for the reasons explained more fully below.

547. A POSITA would have been motivated to modify Mount to include the teachings and emulator of ONE because both of these references relate to systems for emulating mobile communications networks. Both Mount and ONE disclose known and interchangeable uses of an emulator equipment, and a POSITA would have understood that combining a known prior art emulator, disclosed in ONE, with the simulation system of Mount would yield predictable and beneficial results. A POSITA would have understood that Mount and ONE would have been easily combinable. For example, ONE explains that it provides its emulated environment "to a wide variety of hardware and software systems." ONE at 6. Thus, a POSITA would have understood that it would have been easy to adapt the emulator of ONE to work in the system of Mount.

548. Similarly, the '330 Patent itself discusses the ONE emulator and provides that it can "emulate transmission, queuing, and propagation delay between two computers interconnected by a router." '330 Patent at 2:2-9.

549. Because the ONE emulator was a well-known, easily-accessible, and easily-adaptable emulator at the time, as evidenced at least by the '330 Patent itself and the evidence explained in ONE, it is my opinion that a POSITA would have found it obvious to combine the method and apparatus for testing a mobile communications system of Mount with the emulator of ONE.

550. As disclosed in the ’330 Patent itself and as disclosed in ONE, the ONE emulator “models the routers and intervening network by delaying packets arriving on one network interface before forwarding them to the other network. *ONE* also provides congestion loss according to its configuration. The delay a packet experiences is based on the packet size and the configuration parameters given by the user. The following three components of packet delay are modeled.” ONE at 2; *see also* ’330 Patent at 2:2-9.

551. ONE explains that it is able to model “three components of packet delay,” including “transmission delay,” which is “the amount of time it takes a network node to transmit a packet onto a given channel;” “queuing delay,” which “occurs when a packet arrives at a router which is already busy transmitting another packet;” and “propagation delay,” which is “the time it takes a packet to travel from one node to another along a physical channel.” ONE at 2-3. “The sum of the above component delays is the amount of time ONE holds a packet before forwarding it.” ONE at 3.

552. Packet delay is configurable based on “two user configurable parameters:” linespeed and propagation. ONE at 3-4. Packets are queued for transmission based on the following two user-configurable settings: qsize, which is “the size for the given interface,” and memunit, which is “the internal buffer size (memory allocation granularity) used to store packets in the queue.” ONE at 3-4.

553. A POSITA would have understood that because ONE discloses providing congestion loss as well as setting delay with user-configurable parameters, ONE discloses emulating attributes of a packet-based wired communications network including at least one of

tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication.[23]

['330, 1(e)] a controller communicatively linked to each of said plurality of wireless network nodes, said controller configured to control the wireless communication characteristics of each of said plurality of wireless network nodes to simulate, without changing operating parameters of said at least one mobile node, different wireless communication conditions experienced by said at least one mobile node in actual operation.

554. Mount discloses "a controller communicatively linked to each of said plurality of wireless network nodes, said controller configured to control the wireless communication characteristics of each of said plurality of wireless network nodes to simulate, without changing operating parameters of said at least one mobile node, different wireless communication conditions experienced by said at least one mobile node in actual operation." The parties agreed that the term "wireless network nodes" means "an element of a network that sends and receives signals wirelessly." The Court construed the term "communicatively linked" to mean "capable of transmitting and receiving signals via an interface."

555. First, Mount discloses a controller communicatively linked to each of said plurality of wireless network nodes. For example, Mount discloses "[a] parallel I/O circuit 49 (which may include some type of controller)" that "is adapted to receive control signals from the test control system 12" in Figure 1B. Mount at 3:59-63. As explained above, the test control system 12 includes the AES task 114, which "primarily manages movement of the mobile units **14** to control positions of the mobile units **14**." The "AES task **114** can control moving mobile units **14** along directed paths at varying speeds, for example." Mount at 6:9-17. The AES task 114 sends control signals to the parallel I/O circuit 49, and the I/O circuit 49 is similarly communicatively linked to the

[23] To the extent that Mobility contends that Verizon infringes this limitation through its standards compliance testing, *see* '330 Infringement Contentions at 22, standards that pre-date the '330 Patent disclose this limitation for all of the reasons explained above in Section VIII.B. and in the Amended Invalidity Contentions, *see* Exs.C-12 and C-13, which I hereby incorporate by reference.

attenuator array 45. The attenuator array 45 is, as explained above, communicatively linked to the base transceiver stations 28 via antennas 47.

556. Next, Mount discloses controller configured to control the wireless communication characteristics of each of said plurality of wireless network nodes to simulate, without changing operating parameters of said at least one mobile node, different wireless communication conditions experienced by said at least one mobile node in actual operation. I understand that the Court construed the term "without changing operating parameters of said at least one mobile node" to be given its plain meaning. Claim Construction Order at 30. I understand that the parties agreed, and the Court did not disagree, during claim construction that the term "operating parameters" encompasses at least transmit power level. *Id.* I also understand that the specification of the '330 Patent explains numerous times that "attenuation provided by at least one of the attenuators" and controlled by the controller "can be increased," "while simultaneously decreasing attenuation provided by another one of the attenuators," thus simulating movement away from and toward the wireless network nodes. '330 Patent at 2:63-66. The '330 Patent similarly explains that the simulation of movement of the wireless network nodes is performed via adjusting the wireless network nodes' transmit power level without the need to change the transmit power level (or physically move) the mobile node. '330 Patent at 2:25-28, 2:59-28, 3:10-21, 4:37-41, 5:17-25, 6:46-67.

557. I also understand that this limitation is discussed in the file history of the '330 Patent. In response to an anticipation rejection based on U.S. Patent No. 6,735,448 ("Krishnamurthy"), the applicant argued that Krishnamurthy did not anticipate this limitation because the mobile nodes in Krishnamurthy change their "own operating parameters, namely [their] own 'transmit power level.'"'330 File History, Response to Office Action dated Jan. 8,

2007, at 10. I also understand that the applicant pointed to the portion of the specification reciting that "[t]he mobile node 125 need not be a moveable or roaming component as the system 100 is configured to simulate motion of the mobile node 125 . . . despite the mobile node 125 being stationary in nature" to support the disclosure for this limitation. '330 File History, Response to Office Action dated Jan. 8, 2007, at 9 (citing paragraph [0023], lines 1-8 of Specification).

558. Mount similarly discloses a controller that adjusts the transmit power level of the wireless network nodes to simulate movement of the mobile nodes without adjusting the operating parameters of the mobile nodes. For example, Mount discloses that its attenuator matrix "var[ies] strengths of signals transmitted by the mobile units for receipt by the mobile communications system" and that "[b]y varying the attenuation of the signals communicated between the mobile units and the mobile communications system, the mobile units may be made to appear to be moving to the mobile communications system." Mount at Abstract. Like the '330 Patent, Mount explains that simulating movement of the mobile units through varying attenuation of the signals transmitted by the mobile units reduces costs, "since simulation of mobile unit movement removes the need for having to actually physically move mobile units along desired paths during testing," and also providing the possibility to "test a larger number of mobile units and to provide more movement patterns of the mobile units." Mount at 1:55-2:4.

559. Mount discloses that it "manipulat[es] the attenuation values of the RF links (through the attenuator matrix **16**) between the mobile units **14** and base transceiver stations **28**," such that "the MSC **22** senses the mobile units **14** as moving when in fact they may be stationary." Mount at 4:6-14; *see also id.* at 6:36-45, 7:41-49. The attenuator matrix may also simulate obstructions such as buildings by varying the attenuation. Mount at 4:6-14.

560. Mount further states that "[e]ach connection between a cell port 40 and a mobile port 42 contains its own attenuator. In the example illustrated in the FIG. 5, which shows a 3x6 matrix, 18 connections (and thus 18 attenuators) exist between the cell ports 40 and mobile ports 42 in the matrix 16." Mount at 7:36-40. One of ordinary skill in the art would understand that the attenuators are bidirectional radio frequency components, and Figure 5 makes clear that the attenuators are used for both signaling from the cell to particular mobile, and from the mobile to the cell in the return path. Mount further confirms this bidirectional understanding by discussing further components between a mobile and a cell which are also bidirectional and connected to the same signal paths as the attenuators. *See* Mount at 7:54-60. Thus, both the transmitted signal from a cell received by a mobile device, as well as the signal transmitted from a mobile device to a cell would be effected, mimicking radio frequency path loss associated with propagation distance.

561. Although Mount discloses an attenuator matrix to vary the strength of the signals transmitted by the mobile units, Mount discloses that "devices other than attenuators may be used to vary strengths of signals transmitted by the mobile units **14**. For example, instead of the attenuator matrix **16**, another type of signal processing device, which may include amplifiers, attenuators, filters, or other types of circuits, may be coupled to the mobile units. In addition, the signal processing device may be an analog or digital device. In some embodiments, the signal processing device may also be implemented in software." Mount at 3:64-4:5.

5. Analysis—Claim 3

['330, 3(a)] The system of claim 1, wherein said wireless communication characteristics include a signal reception sensitivity.

562. Mount discloses "[t]he system of claim 1, wherein said wireless communication characteristics include a signal reception sensitivity."

563. As explained above regarding Element 1(e), Mount discloses "[a] parallel I/O circuit 49 (which may include some type of controller)" that is connected to the attenuator matrix and "is adapted to receive control signals from the test control system 12" in Figure 1B, including the AES task 114. Mount at 3:59-63. Mount discloses, and a POSITA would have understood, that the AES task, the attenuator matrix, and the parallel I/O circuit, as explained above regarding Element 1(e), adjust the transmit power level and/or signal reception sensitivity of the wireless network nodes, to simulate movement of the mobile nodes without adjusting the operating parameters of the mobile nodes. I hereby incorporate by reference my analysis above regarding Element 1(e). As discussed, the attenuators disclosed by Mount associated with Figure 5 are bidirectional, and therefore effect the sensitivity of the cell detecting signal from a particular mobile device. Mount therefore discloses effecting the sensitivity of the cell for a given mobile.

6. Analysis—Claim 4

['330, 4(a)] The system of claim 1, wherein said wireless communication characteristic includes at least one of signal transmission strength, signal-to-noise ratio (SNR), and bit error rate (BER).

564. Mount discloses "[t]he system of claim 1, wherein said wireless communication characteristic includes at least one of signal transmission strength, signal-to-noise ratio (SNR), and bit error rate (BER)."

565. As explained above regarding Element 1(e), Mount discloses "[a] parallel I/O circuit 49 (which may include some type of controller)" that is connected to the attenuator matrix and "is adapted to receive control signals from the test control system 12" in Figure 1B, including the AES task 114. Mount at 3:59-63. Mount discloses, and a POSITA would have understood, that the AES task, the attenuator matrix, and the parallel I/O circuit, as explained above regarding Element 1(e), adjust the transmit power level, including the signal transmission strength, signal-

to-noise ratio (SNR), and/or bit error rate, of the wireless network nodes, to simulate movement of the mobile nodes without adjusting the operating parameters of the mobile nodes. I hereby incorporate by reference my analysis above regarding Element 1(e).

B. AirAccess Anticipates the Asserted Claims or Renders Them Obvious in View of NIST or ONE

1. AirAccess

566. Spirent AirAccess C2K CDMA Network Emulator Operations Manual ("AirAccess") published in 2001. It therefore qualifies as prior art under 35 U.S.C. §§ 102(a) and (b) (pre-AIA). AirAccess was not cited or considered during the prosecution of the '330 Patent.

567. The Overview of AirAccess provides:

> The AirAccess C2K CDMA Network Emulator is a scaleable performance analysis solution for CDMA terminal manufacturers and service providers. AirAccess combines powerful application software with a high-speed protocol processing engine to provide complete emulation of a multicell CDMA network.

AirAccess at 1.1.

568. AirAccess and the '330 Patent similarly seek to address the problem of emulating movement of a mobile node in a wireless communication network. For example, AirAccess discloses that, in its system, "[t]he movement of the mobile station relative to the [base stations] is simulated by adjusting the transmit power for each sector." AirAccess at 5.4; *see also, e.g.*, '330 Patent at 2:19-32, 2:59-3:3, 3:9-21, 3:27-38.

AirAccess discloses base transceiver stations (BTSs), base station controllers (BSCs), and a wireless terminal (unit under test) operating within a cellular communications network, as shown in Figure 2-1, reproduced below. AirAccess at Fig. 2-1. AirAccess also discloses a channel simulation unit that "provides emulation of up to six CDMA sectors. Each of these sectors can provide a full complement of code channels. The TAS3450 can interface directly

with the UUT via either a digital baseband interface or an analog baseband interface, or indirectly via the TAS5200 RF Converter.” AirAccess at 2.2.1.

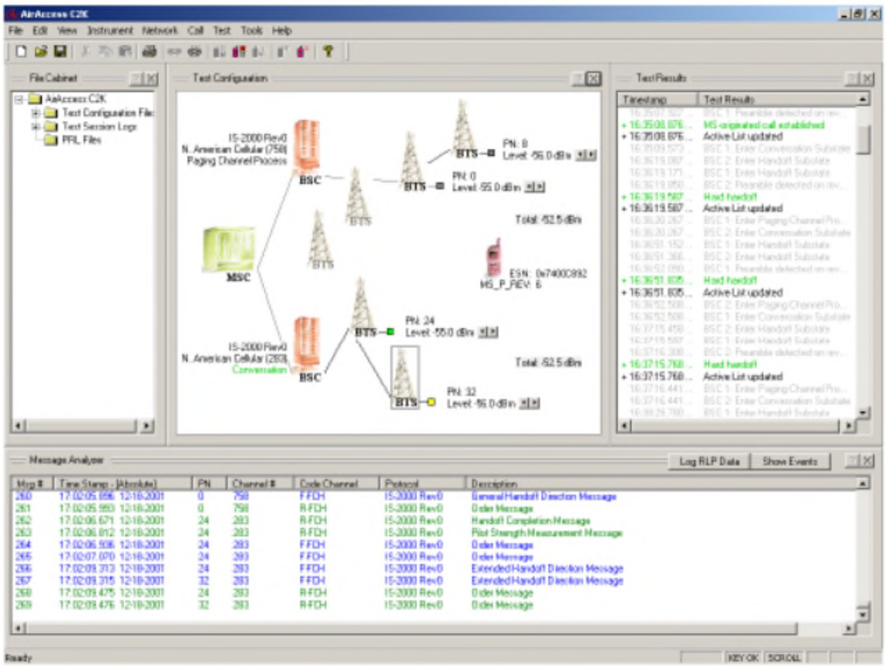


Figure 2-1. AirAccess C2K Screen

2. <u>NIST Net</u>

569. I hereby incorporate by reference my description of NIST Net given in Section XI.A.2.

3. <u>ONE</u>

570. I hereby incorporate by reference my description of ONE given in Section XI.A.3.

4. <u>Analysis—Claim 1</u>

[‘330, 1(a)] A system for emulating mobile network communications comprising:

571. AirAccess discloses “[a] system for emulating mobile network communications.” For example, the Overview of AirAccess provides that it discloses “a scaleable performance analysis solution for CDMA terminal manufacturers and service providers. AirAccess combines

powerful application software with a high-speed protocol processing engine to provide complete emulation of a multicell CDMA network." AirAccess at 1.1. AirAccess explains that it "provides dynamic emulation that is not found in one-box radio test sets or the program-driven conformance test systems currently available" and that it "provides thorough testing of 2G and 3G CDMA mobile devices in a laboratory setting." AirAccess at 1.1.1, 1.1.2.

572. AirAccess goes on to explain that "AirAccess eliminates the need to recreate the complex network depicted above by providing the equivalent functionality in a lab-based solution. AirAccess hardware supplies the ability to create the radio environment necessary for mobile testing, while also providing software emulation of the protocols and standards needed to verify a mobile's ability to interoperate within a CDMA network." AirAccess at 1.2.2.

['330, 1(b)] a plurality of fixedly-located wireless network nodes configured to variably adjust wireless communication characteristics;

573. AirAccess discloses "a plurality of fixedly-located wireless network nodes configured to variably adjust wireless communication characteristics." The parties agreed that the term "fixedly-located" means "set at a particular location" and "wireless network nodes" means "an element of a network that sends and receives signals wirelessly." The Court construed the term "configured to variably adjust wireless communication characteristics" as "configured such that the controller can cause the wireless network nodes to adjust wireless communication characteristics of the wireless network nodes."

574. For example, with reference to Figure 2-1 above, AirAccess discloses base transceiver stations (BTSs), base station controllers (BSCs), and a mobile station operating within a cellular communications network. AirAccess Figure 2-1. A POSITA would have known that

these base transceiver stations would have been fixedly located such that they were set at a particular location.

575. AirAccess discloses that the "[a] single TAS3450 provides emulation of up to six CDMA sectors. Each of these sectors can provide a full complement of code channels. The TAS3450 can interface directly with the UUT via either a digital baseband interface or an analog baseband interface, or indirectly via the TAS5200 RF Converter." AirAccess at 2.2.1. In fact, AirAccess states that the mobile station's connection to AirAccess via the TAS5200 RF Converter is the "[d]efault." AirAccess at 3.2. Because the base transceiver stations are communicatively linked to the TAS3450 and the TAS3450 communicates wirelessly with the mobile stations under test, the base transceiver stations therefore "send[] and receive signals wirelessly" to the mobile units under test. *See* AirAccess Figure 3-3.

576. Finally, the base transceiver stations of AirAccess are "configured to variably adjust wireless communication characteristics" such that they are "configured such that the controller can cause the wireless network nodes to adjust wireless communication characteristics of the wireless network nodes." As explained below regarding Element 1(e), AirAccess discloses a controller communicatively linked to both the base station controller that adjusts the transmit power level of the wireless network nodes to simulate movement of the mobile nodes without adjusting the operating parameters of the mobile nodes. For example, AirAccess discloses that "[t]he TAS5200 RF Converter, as shown in Figure 2-4, provides the conversion to and from dual RF carriers. … The TAS5200 is a versatile RF converter that provides coverage from 400 to 2700 MHz. This includes all ten band classes defined by IMT-2000. It is available in a dual RF carrier model. The frequency and attenuation of the two RF carriers are configured independently."

AirAccess at 2.2.3. When the TAS5200 RF Converter is used, it is possible to access the option to "[s]et RF power range" in the BSC icon." AirAccess at 4.3.2.

577. Without the TAS5200 RF Converter, "[t]he movement of the mobile station relative to the BTSs is simulated by adjusting the transmit power for each sector. This is most easily accomplished using the Gain controls on the Test Configuration window . . . . Alternatively, the transmit power can be adjusted by opening the Configure BTS dialog box and entering a new value." AirAccess at 5.4. It is possible to adjust various parameters within the BTS icon, such as "[s]et sector power" and "[s]et relative code channel gains," for example. AirAccess at 4.3.1.

578. Because AirAccess discloses simulating movement of the mobile station via attenuation, adjusting sector power, and/or adjusting gain controls, AirAccess discloses adjusting transmit power level or other operating parameters to simulate movement of the mobile units. Because AirAccess discloses simulating movement of the mobile station via attenuation, adjusting sector power, and/or adjusting gain controls, AirAccess discloses that the wireless network nodes are "configured to variably adjust wireless communication characteristics."

['330, 1(c)] at least one mobile node configured to wirelessly communicate with selected ones of said plurality of wireless network nodes;

579. AirAccess discloses "at least one mobile node configured to wirelessly communicate with selected ones of said plurality of wireless network nodes." The parties agreed that the term "mobile node configured to wirelessly communicate" means "a device that sends and receives signals wirelessly," and "wireless network nodes" means "an element of a network that sends and receives signals wirelessly.

580. AirAccess discloses that "[t]he CDMA network that a mobile station is required to operate in is a very complex structure consisting of many components. This includes entities such

as multiple base stations, multiple base station controllers, a mobile switching center and servers for applications like authentication, SMS, OTA and data. An example CDMA network is shown in Figure 1-1," below. AirAccess at 1.2.1. As can be seen below, Figure 1-1 shows a "wireless terminal" or the "unit under test."

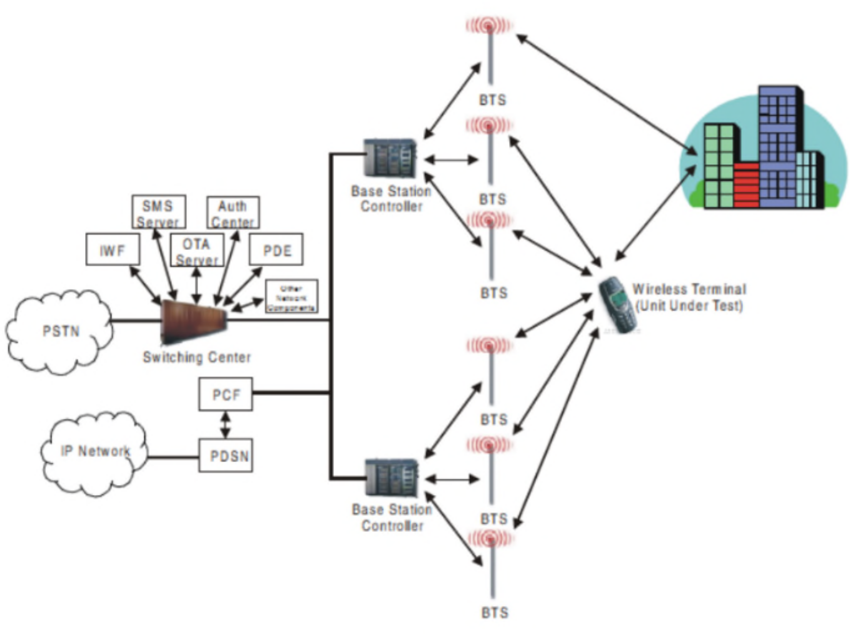


Figure 1-1. Example configuration of a typical CDMA network

581. AirAccess discloses that it "eliminates the need to recreate the complex network depicted above by providing the equivalent functionality in a lab-based solution. AirAccess hardware supplies the ability to create the *radio environment* necessary for mobile testing, while also providing software emulation of the protocols and standards needed to verify a mobile's ability to interoperate within a CDMA network." AirAccess at 1.2.2 (emphasis added).

582. With reference to Figure 2-1 above, AirAccess discloses base transceiver stations (BTSs), base station controllers (BSCs), and a wireless terminal (unit under test) operating within a cellular communications network. AirAccess at Figure 2-1. As explained above with respect to the wireless network nodes, AirAccess discloses that the mobile station's connection to AirAccess

via the TAS5200 RF Converter is the “[d]efault.” AirAccess at 3.2 AirAccess further discloses, for example, that the following four telservices may be selected: wireless paging teleservice (CPT-95), wireless messaging teleservice (CMT-95), voice mail notification (VMN-95), and wireless application protocol (WAP).” AirAccess at 7.2.1. Finally, AirAccess shows that the front panel of the TAS3450 shows an “[a]ir [i]nterface,” connected via IF/RF, as shown in Figure 2-3 below.

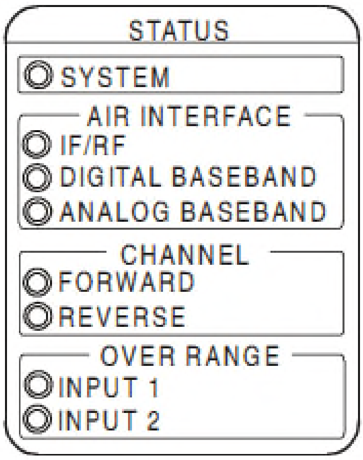


Figure 2-3. TAS3450 LED Indicator Panel

583. It is my opinion that AirAccess satisfies the limitation of the mobile units communicating wirelessly with the wireless network nodes, as described above. To the extent that Mobility argues that AirAccess does not disclose this limitation, it is my opinion that it would have been obvious to a person of ordinary skill in the art to adapt AirAccess to use a wireless connection.

584. I have reviewed Mobility’s infringement contentions, and I understand that Mobility may contend that a wired connection between the mobile nodes and the wireless network nodes infringes claim 1 of the ’330 Patent. For the reasons described above, it is my opinion that AirAccess anticipates and/or renders obvious claim 1 under Mobility’s infringement theory as well.

['330, 1(d)] a network emulator communicatively linked to each of said plurality of wireless network nodes, said network emulator configured to emulate attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network, the emulated attributes comprising at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication; and

585. AirAccess discloses "a network emulator communicatively linked to each of said plurality of wireless network nodes, said network emulator configured to emulate attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network, the emulated attributes comprising at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication." The parties agreed that the term "wireless network nodes" means "an element of a network that sends and receives signals wirelessly" and the term "a packet-based wired communications network" means "a communications network in which packets of data are transmitted through wires or cables." The Court construed the term "communicatively linked" to mean "capable of transmitting and receiving signals via an interface."

586. First, it is my opinion that AirAccess discloses a network emulator that is configured to emulate attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network, the emulated attributes comprising at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication. With reference to Figure 1-1 below, AirAccess discloses a network emulator designed to emulate base station controllers and base station transceivers such that the emulator is communicatively linked to the wireless network nodes.

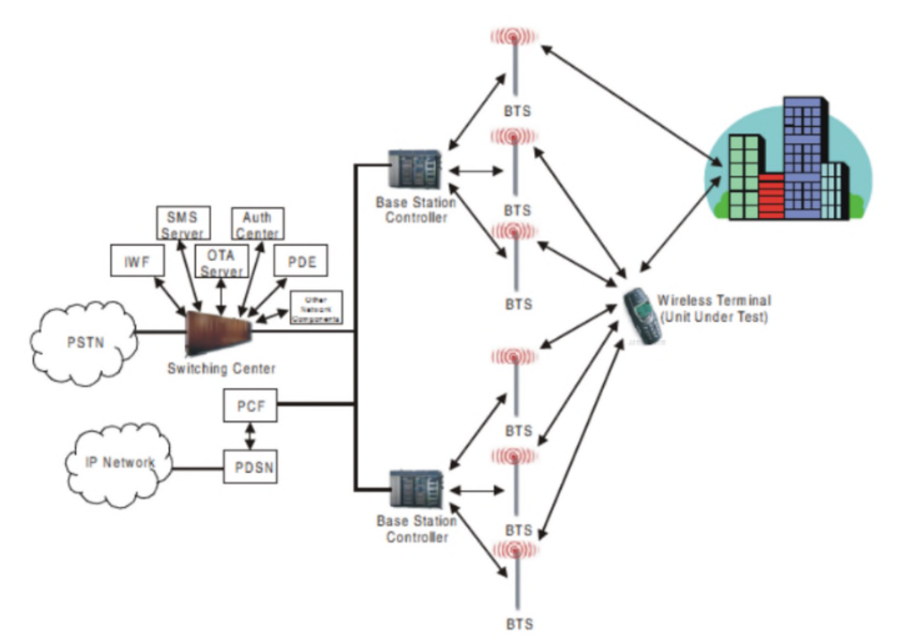


Figure 1-1. Example configuration of a typical CDMA network

587. This emulator emulate attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network, the emulated attributes comprising at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication. For example, AirAccess discloses that a "FFPC allows the mobile station under test to control the forward link fundamental traffic code channel relative power level at the rate of 800 times per second. Similar to 2G reverse link power control where the base station punctures 800 power control bits per second in the data sent to the mobile station, when FFPC is used, the mobile will send 800 power control bits to the base station via the Reverse Pilot Channel. AirAccess will adjust the relative power level of the fundamental traffic channel it transmits (within specified limits) based on the bits received from the mobile station. The limits of the power level are specified on a per BTS basis within AirAccess." AirAccess at 4.10. AirAccess also discloses that the AirAccess GUI can adjust "[p]aging and [f]orward [t]raffic

[c]hannel message insertion." AirAccess at 2.2.1. The AirAccess is also able to "[e]nable or disable packet data call PPP Authentication" and "packet data service test capabilities," including emulation of a Packet Data Service Node (PDSN). AirAccess at 4.3.3, 6.1. Finally, AirAccess discloses that "[t]o emulate channel models or inject noise and interference, optionally the TAS4500 FLEX5 RF Channel Emulator, the TAS4600A Noise and Interference Emulator and/or the TAS5600C Universal Interference Emulator can be inserted between the TAS5200 front-panel connections and the mobile . . . ." AirAccess at 2.4.4.

588. Next, AirAccess discloses that this network emulator is communicatively linked to each of said plurality of wireless network nodes. The network emulator TAS3450 emulates the attributes of a wired packet-based communications network as well as the base station transceivers, and thus, the two are communicatively linked.

589. A POSITA would have known that emulating calls and a traffic environment, including emulation of a Packet Data Service Node (PDSN), would include emulating attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network. Further, a POSITA would have known that this emulation comprises at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication. A POSITA would have known, and it is my opinion, that emulating calls and a traffic environment, including emulation of a Packet Data Service Node (PDSN), would comprise emulation of at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication. For example, a traffic environment necessarily involves emulation of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication simply by the very nature

of emulating traffic. If multiple packets are being passed across the network as traffic, there will necessarily be a limitation on bandwidth, for example.

590. To the extent that Mobility contends that AirAccess does not disclose any portion of this limitation, it would have been obvious to a person of ordinary skill in the art at the time of the alleged invention to adapt the disclosures in AirAccess to include this limitation. Moreover, it would have been obvious to a person of ordinary skill in the art to combine the teachings of AirAccess with the teachings of NIST Net, for the reasons explained more fully below.

591. A POSITA would have been motivated to modify AirAccess to include the teachings and emulator of NIST Net because both of these references relate to systems for emulating mobile communications networks. Both AirAccess and NIST Net disclose known and interchangeable uses of emulator equipment, and a POSITA would have understood that combining a known prior art emulator, disclosed in NIST Net, with the simulation system of AirAccess would yield predictable and beneficial results.

592. Similarly, the '330 Patent itself discusses the NIST Net emulator and provides it as an example of an optimal emulator for satisfying limitation **['330, 1(d)]**.'330 Patent at 5:60-6:2 ("For example, the emulator 110 can be implemented using a computer system executing the National Institute of Standards and Technology (NIST) emulator.").

593. A POSITA would have understood that AirAccess and NIST Net would have been easily combinable. For example, NIST Net explains that it allows "*external* hooks into its module as well. External statistics generation code may supply values for NIST Net's generation of network effects. . . . Alternatively, *external handlers* may work in concert with NIST Net or take over packet processing entirely." NIST Net at 115-116. Thus, a POSITA would have understood that it would have been easy to adapt the emulator of NIST Net to work in the system of AirAccess.

594. Moreover, NIST Net explains that it was easily and widely accessible as "[t]housands of people throughout the world ha[d] successfully installed and used the emulator for a wide variety of projects, even those with no prior experience with Linux. It has proven particularly useful in academic settings for class laboratories and student research projects." NIST Net at 112. In particular, NIST Net explains that in 2003, "[s]ince its initial release, NIST Net ha[d] been obtained by nearly twenty thousand people around the world, and has been used for a wide variety of testing purposes, including for voice over IP, mobile network emulation, adaptive video transmissions, satellite and underseas radio link emulation, and interactive network gaming." NIST Net at 125. Further, NIST Net explains that its code, documentation, and calibration results "are all public domain and are available through its web site." NIST Net at 125.

595. Because the NIST Net emulator was a well-known, easily-accessible, and easily-adaptable emulator at the time, as evidenced at least by the '330 Patent itself and the evidence explained in NIST Net, it is my opinion that a POSITA would have found it obvious to combine the method and apparatus for testing a mobile communications system of AirAccess with the emulator of NIST Net.

596. As disclosed in the '330 Patent itself and as disclosed in NIST Net, the NIST Net emulator is "a tool to facilitate testing and experimentation with network code through emulation. NIST Net enables experimenters to model and effect arbitrary performance dynamics (packet delay, jitter, bandwidth limitations, congestion, packet loss and duplication) on live IP packets passing through a commodity Linux-based PC router." NIST Net at Abstract; *see also* '330 Patent at 5:60-6:2.

597. NIST Net similarly explains that "it provides the ability to emulate common network effects such as packet loss, duplication or delay; router congestion; and bandwidth

limitations. It is designed to offer sufficient capabilities and performance to reproduce a wide range of network behaviors (forwarding rates of up to 1 Gbps, satellite-like delays or longer, asymmetric characteristics), while requiring only commodity PC hardware and operating systems." NIST Net at 111.

598. NIST Net explains that "[a] useful way to think of NIST Net is as a "network-in-a-box" (Figure 1) — a specialized router which emulates (statistically) the behavior of an entire network in a single hop. NIST Net selectively applies network effects (such as delay, loss, jitter) to traffic passing through it, based on user-supplied settings." NIST Net at 112. Specifically, the "set of network effects NIST Net can impose includes: packet delay, both fixed and variable (jitter); packet reordering; packet loss, both random and congestion-dependent; packet duplication; and bandwidth limitations." NIST Net at 112. NIST Net goes on to explain in detail how its packet delay, packet loss, packet duplication, packet reordering, congestion, and bandwidth limitations are calculated. NIST Net at 113-114, 118-119, 123-124.

599. The NIST Net graphical user interface showing the ability to adjust these various parameters is shown at Figure 3 below.

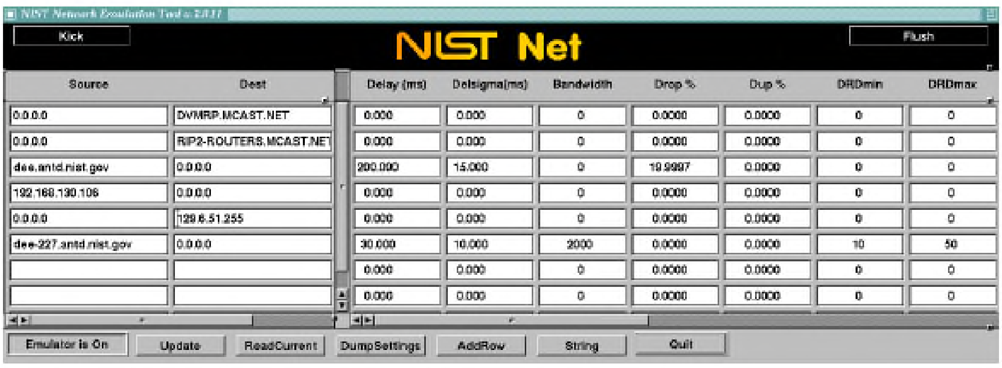


Figure 3: NIST Net graphical user interface

600. Thus, NIST Net discloses emulating attributes of a packet-based wired communications network including at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication.

601. To the extent that Mobility contends that AirAccess does not disclose any portion of this limitation, it would have been obvious to a person of ordinary skill in the art at the time of the alleged invention to adapt the disclosures in AirAccess to include this limitation. Moreover, it would have been obvious to a person of ordinary skill in the art to combine the teachings of AirAccess with the teachings of ONE, for the reasons explained more fully below.

602. A POSITA would have been motivated to modify AirAccess to include the teachings and emulator of ONE because both of these references relate to systems for emulating mobile communications networks. Both AirAccess and ONE disclose known and interchangeable uses of an emulator equipment, and a POSITA would have understood that combining a known prior art emulator, disclosed in ONE, with the simulation system of AirAccess would yield predictable and beneficial results. A POSITA would have understood that AirAccess and ONE would have been easily combinable. For example, ONE explains that it provides its emulated environment "to a wide variety of hardware and software systems." ONE at 6. Thus, a POSITA would have understood that it would have been easy to adapt the emulator of ONE to work in the system of AirAccess.

603. Similarly, the '330 Patent itself discusses the ONE emulator and provides that it can "emulate transmission, queuing, and propagation delay between two computers interconnected by a router." '330 Patent at 2:2-9.

604. Because the ONE emulator was a well-known, easily-accessible, and easily-adaptable emulator at the time, as evidenced at least by the '330 Patent itself and the evidence

explained in ONE, it is my opinion that a POSITA would have found it obvious to combine the method and apparatus for testing a mobile communications system of AirAccess with the emulator of ONE.

605. As disclosed in the ’330 Patent itself and as disclosed in ONE, the ONE emulator “models the routers and intervening network by delaying packets arriving on one network interface before forwarding them to the other network. *ONE* also provides congestion loss according to its configuration. The delay a packet experiences is based on the packet size and the configuration parameters given by the user. The following three components of packet delay are modeled.” ONE at 2; *see also* ’330 Patent at 2:2-9.

606. ONE explains that it is able to model “three components of packet delay,” including “transmission delay,” which is “the amount of time it takes a network node to transmit a packet onto a given channel;” “queuing delay,” which “occurs when a packet arrives at a router which is already busy transmitting another packet;” and “propagation delay,” which is “the time it takes a packet to travel from one node to another along a physical channel.” ONE at 2-3. “The sum of the above component delays is the amount of time ONE holds a packet before forwarding it.” ONE at 3.

607. Packet delay is configurable based on “two user configurable parameters:” linespeed and propagation. ONE at 3-4. Packets are queued for transmission based on the following two user-configurable settings: qsize, which is “the size for the given interface,” and memunit, which is “the internal buffer size (memory allocation granularity) used to store packets in the queue.” ONE at 3-4.

608. A POSITA would have understood that because ONE discloses providing congestion loss as well as setting delay with user-configurable parameters, ONE discloses

emulating attributes of a packet-based wired communications network including at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication.[24]

[‘330, 1(e)] a controller communicatively linked to each of said plurality of wireless network nodes, said controller configured to control the wireless communication characteristics of each of said plurality of wireless network nodes to simulate, without changing operating parameters of said at least one mobile node, different wireless communication conditions experienced by said at least one mobile node in actual operation.

609. AirAccess discloses “a controller communicatively linked to each of said plurality of wireless network nodes, said controller configured to control the wireless communication characteristics of each of said plurality of wireless network nodes to simulate, without changing operating parameters of said at least one mobile node, different wireless communication conditions experienced by said at least one mobile node in actual operation.” The parties agreed that the term “wireless network nodes” means “an element of a network that sends and receives signals wirelessly.” The Court construed the term “communicatively linked” to mean “capable of transmitting and receiving signals via an interface.”

610. First, AirAccess discloses a controller communicatively linked to each of said plurality of wireless network nodes. For example, AirAccess discloses that a “TAS5200 RF Converter, . . . , [that] provides the conversion to and from dual RF carriers. . . . The TAS5200 is a versatile RF converter that provides coverage from 400 to 2700 MHz. This includes all ten band classes defined by IMT-2000. It is available in a dual RF carrier model. The frequency and attenuation of the two RF carriers are configured independently.” AirAccess at 2.2.3. When using the TAS5200 RF Converter, it is possible to “[s]et RF power range” through “[t]he BSC icon(s) in

[24] To the extent that Mobility contends that Verizon infringes this limitation through its standards compliance testing, *see* ’330 Infringement Contentions at 22, standards that pre-date the ’330 Patent disclose this limitation for all of the reasons explained above in Section VIII.B. and in the Amended Invalidity Contentions, *see* Exs.C-12 and C-13, which I hereby incorporate by reference.

the Test Configuration window.” AirAccess at 4.3.2. Thus, AirAccess discloses an RF carrier communicatively linked to the BSCs, which, in turn, is communicatively linked to the base transceiver stations, *see* AirAccess at 4.3.2, which controls simulation of attenuation between the base transceiver stations and mobile units, for example.

611. Moreover, AirAccess provides that “movement of the mobile station relative to the BTSs” may be “simulated by adjusting the transmit power for each sector” without using the TAS5200 RF Converter. AirAccess at 5.4. “This is most easily accomplished using the Gain controls on the Test Configuration window (see Figure 4-2). Alternatively, the transmit power can be adjusted by opening the Configure BTS dialog box and entering a new value.” AirAccess at 5.4. This can be seen through Figures 4-3 and 4-4 below.

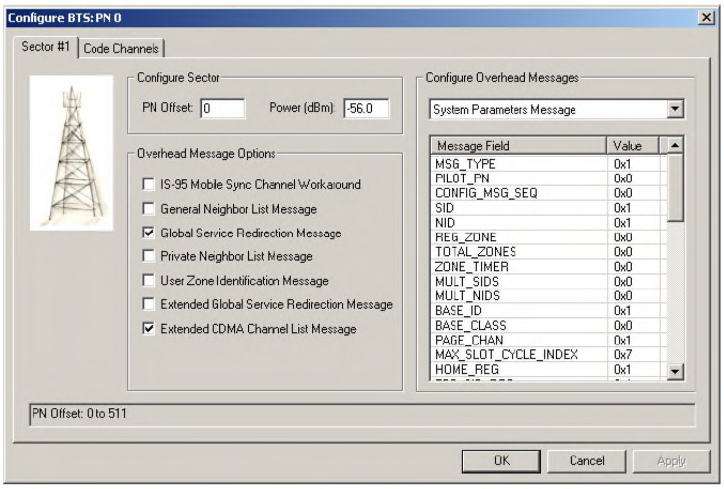


Figure 4-3. BTS Configuration window – Tab 1

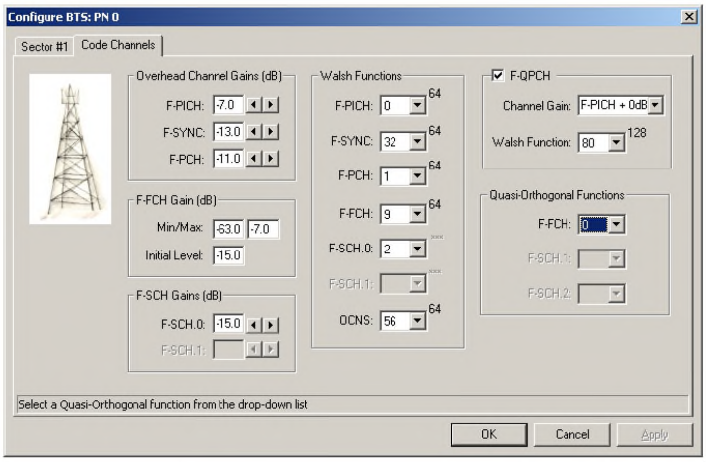


Figure 4-4. BTS Configuration window – Code Channels Tab

612. Because movement of the mobile station is controlled via adjusting the communication characteristics of the BTS, the controller of AirAccess is communicatively linked to the plurality of wireless network nodes.

613. Next, AirAccess discloses that the controller is configured to control the wireless communication characteristics of each of said plurality of wireless network nodes to simulate, without changing operating parameters of said at least one mobile node, different wireless communication conditions experienced by said at least one mobile node in actual operation. I understand that the Court construed the term “without changing operating parameters of said at least one mobile node” to be given its plain meaning. Claim Construction Order at 30. I understand that the parties agreed, and the Court did not disagree, during claim construction that the term “operating parameters” encompasses at least transmit power level. *Id.* I also understand that the specification of the ’330 Patent explains numerous times that “attenuation provided by at least one of the attenuators” and controlled by the controller “can be increased,” “while simultaneously decreasing attenuation provided by another one of the attenuators,” thus simulating movement away from and toward the wireless network nodes. ’330 Patent at 2:63-66. The ’330 Patent

similarly explains that the simulation of movement of the wireless network nodes is performed via adjusting the wireless network nodes' transmit power level without the need to change the transmit power level (or physically move) the mobile node. '330 Patent at 2:25-28, 2:59-28, 3:10-21, 4:37-41, 5:17-25, 6:46-67.

614. I also understand that this limitation is discussed in the file history of the '330 Patent. In response to an anticipation rejection based on U.S. Patent No. 6,735,448 ("Krishnamurthy"), the applicant argued that Krishnamurthy did not anticipate this limitation because the mobile nodes in Krishnamurthy change their "own operating parameters, namely [their] own 'transmit power level.'" '330 File History, Response to Office Action dated Jan. 8, 2007, at 10. I also understand that the applicant pointed to the portion of the specification reciting that "[t]he mobile node 125 need not be a moveable or roaming component as the system 100 is configured to simulate motion of the mobile node 125 . . . despite the mobile node 125 being stationary in nature" to support the disclosure for this limitation. '330 File History, Response to Office Action dated Jan. 8, 2007, at 9 (citing paragraph [0023], lines 1-8 of Specification).

615. AirAccess similarly discloses a controller that adjusts the transmit power level of the wireless network nodes to simulate movement of the mobile nodes without adjusting the operating parameters of the mobile nodes. For example, AirAccess discloses that "[t]he TAS5200 RF Converter, as shown in Figure 2-4, provides the conversion to and from dual RF carriers. … The TAS5200 is a versatile RF converter that provides coverage from 400 to 2700 MHz. This includes all ten band classes defined by IMT-2000. It is available in a dual RF carrier model. The frequency and attenuation of the two RF carriers are configured independently." AirAccess at 2.2.3. When the TAS5200 RF Converter is used, it is possible to access the option to "[s]et RF power range" in the BSC icon." AirAccess at 4.3.2.

616. Without the TAS5200 RF Converter, "[t]he movement of the mobile station relative to the BTSs is simulated by adjusting the transmit power for each sector. This is most easily accomplished using the Gain controls on the Test Configuration window . . . . Alternatively, the transmit power can be adjusted by opening the Configure BTS dialog box and entering a new value." AirAccess at 5.4. It is possible to adjust various parameters within the BTS icon, such as "[s]et sector power" and "[s]et relative code channel gains," for example. AirAccess at 4.3.1.

617. Because AirAccess discloses simulating movement of the mobile station via attenuation, adjusting sector power, and/or adjusting gain controls, AirAccess discloses adjusting transmit power level or other operating parameters to simulate movement of the mobile units. A POSITA would have understood that this simulation would have been performed without changing the operating parameters of the mobile units, as AirAccess discloses that the mobile units are "under test." AirAccess at 1.2.2., 8.1 Generally, when performing tests on mobile units to determine their operating capabilities in a wireless communications network, the parameters of the mobile units are not changed so as to not introduce any additional variables into the testing environment.

5. Analysis—Claim 3

['330, 3(a)] The system of claim 1, wherein said wireless communication characteristics include a signal reception sensitivity.

618. AirAccess discloses "[t]he system of claim 1, wherein said wireless communication characteristics include a signal reception sensitivity."

619. As explained above in regarding Element 1(e), AirAccess discloses simulating movement of the mobile station via attenuation, adjusting sector power, and/or adjusting gain controls. AirAccess at 2.2.3, 4.3.1, 5.4. AirAccess discloses, and a POSITA would have understood, that the controller of AirAccess adjusts the transmit power level and/or signal

reception sensitivity of the wireless network nodes, to simulate movement of the mobile nodes without adjusting the operating parameters of the mobile nodes. I hereby incorporate by reference my analysis above regarding Element 1(e).

6. Analysis—Claim 4

['330, 4(a)] The system of claim 1, wherein said wireless communication characteristic includes at least one of signal transmission strength, signal-to-noise ratio (SNR), and bit error rate (BER).

620. AirAccess discloses "[t]he system of claim 1, wherein said wireless communication characteristic includes at least one of signal transmission strength, signal-to-noise ratio (SNR), and bit error rate (BER)."

621. As explained above regarding Element 1(e), AirAccess discloses simulating movement of the mobile station via attenuation, adjusting sector power, and/or adjusting gain controls. AirAccess at 2.2.3, 4.3.1, 5.4. AirAccess discloses, and a POSITA would have understood, that the controller of AirAccess adjusts the transmit power level, including the signal transmission strength, signal-to-noise ratio (SNR), and/or bit error rate, of the wireless network nodes, to simulate movement of the mobile nodes without adjusting the operating parameters of the mobile nodes. I hereby incorporate by reference my analysis above in regarding Element 1(e).

622. AirAccess further discloses that "Figure 4-7 shows the Forward Link Power Control configuration tab. Within this tab, the forward link power control settings are configured. When the TAS5200 is used for RF conversion, a 25 dB RF Power Range window for the forward link is specified in this section. This Power Range window defines the minimum and maximum RF levels that can be achieved from the combined forward links of all of the BTSs associated with the BSC being configured. This section also provides the ability to enable Fast Forward Power Control (FFPC) by specifying the Forward Power Control (FPC) mode as '000'. When FFPC is

enabled, additional power control parameters are configurable. These include Target FER, Initial Eb/Nt Setpoint, and Eb/Nt Setpoint Range. The mobile station under test uses these parameters to determine how to power control the forward link transmission from AirAccess." Air Access at 4.3.2.

C. Rimoni Anticipates the Asserted Claims or Renders Them Obvious in View of NIST

1. Rimoni

623. Rimoni, U.S. Patent Application Publication No. US 2002/0183054, was filed on April 8, 2002 and published on December 5, 2002. It therefore qualifies as prior art under 35 U.S.C. §§ 102(a) and (e) (pre-AIA). Rimoni was not cited or considered during the prosecution of the '330 Patent.

624. The Abstract of Rimoni provides:

> Apparatus for testing one or more mobiles, each mobile being adapted to transmit and receive respective signals compatible with a cellular communications network. The apparatus includes station simulation circuitry which is adapted to simulate a plurality of base station controllers (BSCs) operative simultaneously in the cellular communications network. The apparatus also includes mobile interface circuitry which is coupled to transfer the respective signals between the station simulation circuitry and the one or more mobiles.

Rimoni at Abstract.

625. Rimoni and the '330 Patent similarly seek to address the problem of emulating movement of a mobile node in a wireless communication network. For example, Rimoni discloses "simulating the one or more communication channels includes simulating one or more of effects selected from a group consisting of noise, fading, attenuation, delay, Doppler shift, and reflection in channel simulation circuitry." Rimoni at [0042]; *see also, e.g.*, '330 Patent at 2:19-32, 2:59-3:3, 3:9-21, 3:27-38.

Rimoni discloses base transceiver stations (BTSs) 21, base station controllers (BSCs) 23, and mobile units 35 operating within a cellular communications network 25, as shown in Figure 1, reproduced below. Rimoni at [0057]; Fig. 1. Rimoni also discloses a channel simulation unit 30 that "is implemented to simulate one or more cellular network channels for conveying signals between simulator 28 and one or more units-under test (UUT) 36." Rimoni at [0058].

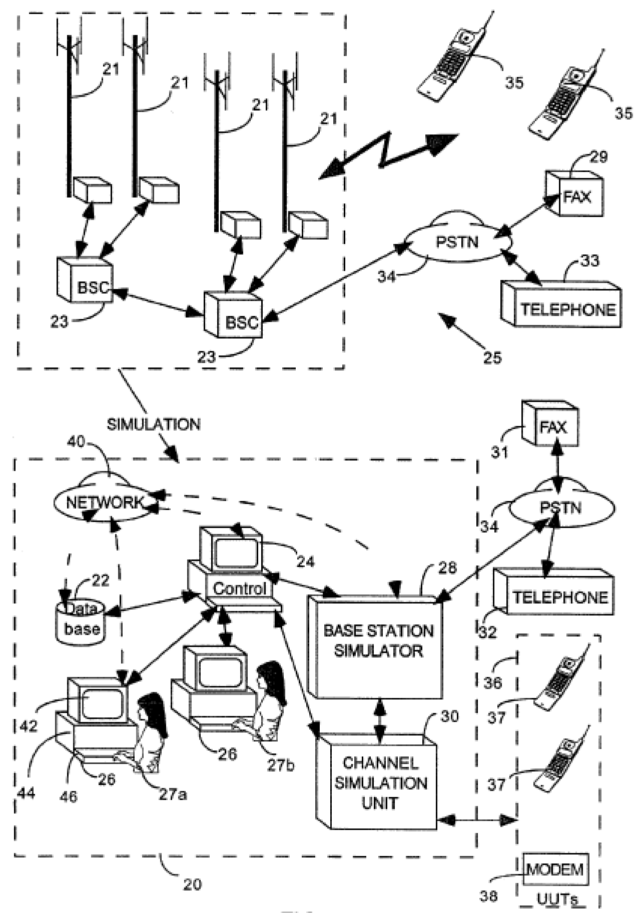


FIG. 1

2. NIST Net

626. I hereby incorporate by reference my description of NIST Net given in Section XI.A.2.

3. ONE

627. I hereby incorporate by reference my description of ONE given in Section XI.A.3.

4. Analysis—Claim 1

[‘330, 1(a)] A system for emulating mobile network communications comprising:

628. Rimoni discloses “[a] system for emulating mobile network communications.” For example, the Abstract of Rimoni provides that it discloses an “[a]pparatus for testing one or more mobiles, each mobile being adapted to transmit and receive respective signals compatible with a cellular communications network. The apparatus includes station simulation circuitry which is adapted to simulate a plurality of base station controllers (BSCs) operative simultaneously in the cellular communications network. The apparatus also includes mobile interface circuitry which is coupled to transfer the respective signals between the station simulation circuitry and the one or more mobiles.” Rimoni at Abstract. As shown in Figure 1, the apparatus of Rimoni includes mobile units 35 “operating within a cellular communications network 25” as well as a [s]imulator 28 [that] generates signals which simulate the activity of the one or more BSCs, and so acts as a base station simulation system.” Rimoni at [0058].

629. Rimoni goes on to explain that “[t]he present invention relates generally to testing systems, and specifically to testing cellular communications networks” and that “[i]t is an object of some aspects of the present invention to provide an improved method and apparatus for testing a cellular mobile.” Rimoni at [0003], [0011].

[‘330, 1(b)] a plurality of fixedly-located wireless network nodes configured to variably adjust wireless communication characteristics;

630. Rimoni discloses “a plurality of fixedly-located wireless network nodes configured to variably adjust wireless communication characteristics.” The parties agreed that the term “fixedly-located” means “set at a particular location” and “wireless network nodes” means “an

element of a network that sends and receives signals wirelessly." The Court construed the term "configured to variably adjust wireless communication characteristics" as "configured such that the controller can cause the wireless network nodes to adjust wireless communication characteristics of the wireless network nodes."

631. For example, with reference to Figure 1 above, Rimoni discloses base transceiver stations (BTSs) 21, base station controllers (BSCs) 23, and mobile units 35 operating within a cellular communications network 25. Rimoni at [0057]; Fig. 1. Rimoni further discloses a "[t]esting system **20** [that] simulates communications between" the BTSs 21, BSCs 23, and "one or more generally similar mobile units **35** operating within a cellular communications network **25**." Rimoni at [0057].

632. A POSITA would have known that these base transceiver stations 21 would have been fixedly located such that they were set at a particular location. Rimoni discloses that the units under test 36 "most preferably comprise one or more mobiles **37** which have been designed to receive and transmit signals compatible with signals produced by the one or more BTSs **21**." Rimoni at [0059]. Preferably, those signals are CDMA signals. Rimoni at [0059]. Rimoni furthermore discloses that "the simulator operates as an interface between" the BTSs and the mobile being tested. The simulator "performs digital-to-digital and digital-to-RF conversions, so as to simulate RF communication between the one or more base stations and each of the mobiles under test via the allocated channels, and to incorporate 'real-world' signal effects into the channels." Rimoni at [0013]; [0096]. Thus, the base transceiver stations 28 "send[] and receive signals wirelessly" to the mobile units under test.

633. Finally, the base transceiver stations 21 of Rimoni are "configured to variably adjust wireless communication characteristics" such that they are "configured such that the

controller can cause the wireless network nodes to adjust wireless communication characteristics of the wireless network nodes." As explained below regarding Element 1(e), Rimoni discloses a controller 24 communicatively linked to both the base station simulator 28 (which, in turn, is communicatively linked to the base transceiver stations 21, Rimoni at [0058]) and the channel simulation unit 30, which controls simulation of attenuation between the base transceiver stations and mobile units, for example. Rimoni at [0060], [0023]. Within the channel simulation unit 30, Rimoni discloses "one or more digital circuit boards (DCBs), wherein the one or more DCBs are adapted to simulate one or more of effects selected from a group consisting of noise, fading, attenuation, delay, Doppler shift, and reflection." Rimoni at [0023]; *see also id.* at [0042]. The DCB 132 simulates these effects "based on a model of expected motion of a specific UUT 36 (such as traveling in an automobile) and expected environment considerations, such as reflections from buildings in a path between the UUT and the base station or stations with which it is in communication." Rimoni at [0096]. Because the DCBs "simulate one or more of effects selected from a group consisting of noise, fading, attenuation, delay, Doppler shift, and reflection" to "model . . . expected motion of a specific" unit under test, Rimoni discloses that the wireless network nodes are "configured to variably adjust wireless communication characteristics."

['330, 1(c)] at least one mobile node configured to wirelessly communicate with selected ones of said plurality of wireless network nodes;

634. Rimoni discloses "at least one mobile node configured to wirelessly communicate with selected ones of said plurality of wireless network nodes." The parties agreed that the term "mobile node configured to wirelessly communicate" means "a device that sends and receives signals wirelessly" and "wireless network nodes" means "an element of a network that sends and receives signals wirelessly.

635. For example, with reference to Figure 1 above, Rimoni discloses base transceiver stations (BTSs) 21, base station controllers (BSCs) 23, and mobile units 35 operating within a cellular communications network 25. Rimoni at [0057]. Rimoni discloses that the coupling between channel simulation unit 30 and the unit under test is "preferably by wireless coupling." Rimoni at [0059].

636. As explained above with respect to the wireless network nodes, Rimoni discloses that the units under test 36 "most preferably comprise one or more mobiles **37** which have been designed to receive and transmit signals compatible with signals produced by the one or more BTSs **21**." Rimoni at [0059]. Preferably, those signals are CDMA signals. Rimoni at [0059]. Rimoni furthermore discloses that "the simulator operates as an interface between" the BTSs and the mobile being tested. The simulator "performs digital-to-digital and digital-to-RF conversions, so as to simulate RF communication between the one or more base stations and each of the mobiles under test via the allocated channels, and to incorporate "real-world" signal effects into the channels." Rimoni at [0013]; [0096]." Thus, Rimoni discloses that the mobile nodes are configured to communicate wirelessly with selected ones of the wireless network nodes.

637. It is my opinion that Rimoni satisfies the limitation of the mobile units communicating wirelessly with the wireless network nodes, as described above. To the extent that Mobility argues that Rimoni does not disclose this limitation, it is my opinion that it would have been obvious to a person of ordinary skill in the art to adapt Rimoni to use a wireless connection.

638. I have reviewed Mobility's infringement contentions, and I understand that Mobility may contend that a wired connection between the mobile nodes and the wireless network nodes infringes claim 1 of the '330 Patent. For the reasons described above, it is my opinion that Rimoni anticipates and/or renders obvious claim 1 under Mobility's infringement theory as well.

[‘330, 1(d)] a network emulator communicatively linked to each of said plurality of wireless network nodes, said network emulator configured to emulate attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network, the emulated attributes comprising at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication; and

639. Rimoni discloses “a network emulator communicatively linked to each of said plurality of wireless network nodes, said network emulator configured to emulate attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network, the emulated attributes comprising at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication.” The parties agreed that the term “wireless network nodes” means “an element of a network that sends and receives signals wirelessly” and the term “a packet-based wired communications network” means “a communications network in which packets of data are transmitted through wires or cables.” The Court construed the term “communicatively linked” to mean “capable of transmitting and receiving signals via an interface.”

640. First, it is my opinion that Rimoni discloses a network emulator that is configured to emulate attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network, the emulated attributes comprising at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication. For example, Rimoni discloses a base station simulator 28, including a signaling channel management section 78. Rimoni at [0079]. Signal channeling management 78 includes several components, including, for example, a “call resource manager component 96”

which "manages the allocation, configuration, control, and de-allocation of resources used by dedicated channels of a specific BSC defined by each user **27** in base station section **52**." Rimoni at [0086]. Signal channeling management 78 also includes both a forward dedicated processing component 100 and reverse dedicated processing component 102. Rimoni at [0089], [0090]. The forward dedicated processing 100 sends data to the forward traffic element 104, and the data, in turn, is sent to channel simulation unit 30. Rimoni at [0092]. Moreover, each traffic element 104 handles forward traffic channels by most preferably assigning each traffic channel attributes as shown in Tables VI and VII." Rimoni at [0092]. The user 27 defines "channels used within each sector by assigning each paging channel attributes as shown in Tables I and II," such as half or full-rate transmission, and a maximum frame period used by the channel. Rimoni at [0071].

641. During a test call, "BSC **23** transfers to a paging state **156**, wherein a general page message **172**, comprising a specification of a type of service, typically voice service, required by BSC **23**, is sent from BSC **23** to the specific mobile called by the land-based telephone." Rimoni at [0100]. "If the mobile is able to answer the general page message, it sends a page response message **174** to the BSC. When BSC **23** receives page response **174**, the BSC transfers to a resource verification/allocation state **158**. In state **158** BSC **23** checks that resources in the form of traffic channels are available for the call, allocates the resources, and sends an extended channel assignment message **176** to the mobile." Rimoni at [0100].

642. Next, Rimoni discloses that this network emulator is communicatively linked to each of said plurality of wireless network nodes. For example, Rimoni discloses that the base station simulator 28 is communicatively linked to the base transceiver stations 21. Rimoni at [0058].

643. A POSITA would have known that emulating calls and a traffic environment, including allocating resources and assigning channel attributes such as the rate of transmission, are attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network. Further, a POSITA would have known that this emulation comprises at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication. A POSITA would have known, and it is my opinion, that emulating calls and a traffic environment, including allocating resources and assigning channel attributes such as the rate of transmission, would comprise emulation of at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication. For example, a traffic environment necessarily involves emulation of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication simply by the very nature of emulating traffic. If multiple packets are being passed across the network as traffic, there will necessarily be a limitation on bandwidth, for example.

644. To the extent that Mobility contends that Rimoni does not disclose any portion of this limitation, it would have been obvious to a person of ordinary skill in the art at the time of the alleged invention to adapt the disclosures in Rimoni to include this limitation. Moreover, it would have been obvious to a person of ordinary skill in the art to combine the teachings of Rimoni with the teachings of NIST Net, for the reasons explained more fully below.

645. A POSITA would have been motivated to modify Rimoni to include the teachings and emulator of NIST Net because both of these references relate to systems for emulating mobile communications networks. Both Rimoni and NIST Net disclose known and interchangeable uses of emulator equipment, and a POSITA would have understood that combining a known prior art

emulator, disclosed in NIST Net, with the simulation system of Rimoni would yield predictable and beneficial results.

646. Similarly, the ’330 Patent itself discusses the NIST Net emulator and provides it as an example of an optimal emulator for satisfying limitation **[‘330, 1(d)]**.’330 Patent at 5:60-6:2 (“For example, the emulator 110 can be implemented using a computer system executing the National Institute of Standards and Technology (NIST) emulator.”).

647. A POSITA would have understood that Rimoni and NIST Net would have been easily combinable. For example, Rimoni discloses that “[t]he control unit can also be coupled to off-the-shelf test equipment 148, for evaluating the performance of unit 30” and that “each user 27 is able to generate one or more behavior executable files, according to one or more test scenarios that the user requires run on UUTs 36.” Rimoni at [0098], [0101]. Further for example, NIST Net explains that it allows “*external* hooks into its module as well. External statistics generation code may supply values for NIST Net's generation of network effects. . . . Alternatively, *external handlers* may work in concert with NIST Net or take over packet processing entirely.” NIST Net at 115-116. Thus, a POSITA would have understood that it would have been easy to adapt the emulator of NIST Net to work in the system of Rimoni.

648. Moreover, NIST Net explains that it was easily and widely accessible as “[t]housands of people throughout the world ha[d] successfully installed and used the emulator for a wide variety of projects, even those with no prior experience with Linux. It has proven particularly useful in academic settings for class laboratories and student research projects.” NIST Net at 112. In particular, NIST Net explains that in 2003, “[s]ince its initial release, NIST Net ha[d] been obtained by nearly twenty thousand people around the world, and has been used for a wide variety of testing purposes, including for voice over IP, mobile network emulation, adaptive

video transmissions, satellite and underseas radio link emulation, and interactive network gaming." NIST Net at 125. Further, NIST Net explains that its code, documentation, and calibration results "are all public domain and are available through its web site." NIST Net at 125.

649. Because the NIST Net emulator was a well-known, easily-accessible, and easily-adaptable emulator at the time, as evidenced at least by the '330 Patent itself and the evidence explained in NIST Net, it is my opinion that a POSITA would have found it obvious to combine the method and apparatus for testing a mobile communications system of Rimoni with the emulator of NIST Net.

650. As disclosed in the '330 Patent itself and as disclosed in NIST Net, the NIST Net emulator is "a tool to facilitate testing and experimentation with network code through emulation. NIST Net enables experimenters to model and effect arbitrary performance dynamics (packet delay, jitter, bandwidth limitations, congestion, packet loss and duplication) on live IP packets passing through a commodity Linux-based PC router." NIST Net at Abstract; *see also* '330 Patent at 5:60-6:2.

651. NIST Net similarly explains that "it provides the ability to emulate common network effects such as packet loss, duplication or delay; router congestion; and bandwidth limitations. It is designed to offer sufficient capabilities and performance to reproduce a wide range of network behaviors (forwarding rates of up to 1 Gbps, satellite-like delays or longer, asymmetric characteristics), while requiring only commodity PC hardware and operating systems." NIST Net at 111.

652. NIST Net explains that "[a] useful way to think of NIST Net is as a "network-in-a-box" (Figure 1) — a specialized router which emulates (statistically) the behavior of an entire network in a single hop. NIST Net selectively applies network effects (such as delay, loss, jitter)

to traffic passing through it, based on user-supplied settings." NIST Net at 112. Specifically, the "set of network effects NIST Net can impose includes: packet delay, both fixed and variable (jitter); packet reordering; packet loss, both random and congestion-dependent; packet duplication; and bandwidth limitations." NIST Net at 112. NIST Net goes on to explain in detail how its packet delay, packet loss, packet duplication, packet reordering, congestion, and bandwidth limitations are calculated. NIST Net at 113-114, 118-119, 123-124.

653. The NIST Net graphical user interface showing the ability to adjust these various parameters is shown at Figure 3 below.

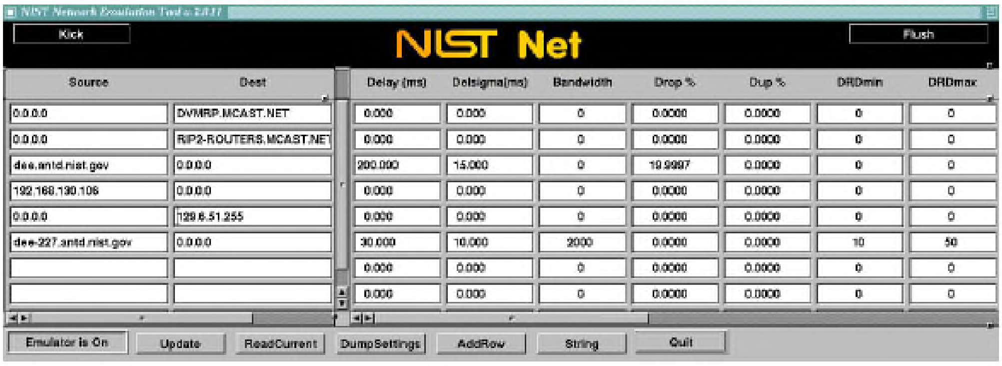


Figure 3: NIST Net graphical user interface

654. Thus, NIST Net discloses emulating attributes of a packet-based wired communications network including at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication.

655. To the extent that Mobility contends that Rimoni does not disclose any portion of this limitation, it would have been obvious to a person of ordinary skill in the art at the time of the alleged invention to adapt the disclosures in Rimoni to include this limitation. Moreover, it would have been obvious to a person of ordinary skill in the art to combine the teachings of Rimoni with the teachings of ONE, for the reasons explained more fully below.

656. A POSITA would have been motivated to modify Rimoni to include the teachings and emulator of ONE because both of these references relate to systems for emulating mobile communications networks. Both Rimoni and ONE disclose known and interchangeable uses of an emulator equipment, and a POSITA would have understood that combining a known prior art emulator, disclosed in ONE, with the simulation system of Rimoni would yield predictable and beneficial results. A POSITA would have understood that Rimoni and ONE would have been easily combinable. For example, ONE explains that it provides its emulated environment "to a wide variety of hardware and software systems." ONE at 6. Thus, a POSITA would have understood that it would have been easy to adapt the emulator of ONE to work in the system of Rimoni.

657. Similarly, the '330 Patent itself discusses the ONE emulator and provides that it can "emulate transmission, queuing, and propagation delay between two computers interconnected by a router." '330 Patent at 2:2-9.

658. Because the ONE emulator was a well-known, easily-accessible, and easily-adaptable emulator at the time, as evidenced at least by the '330 Patent itself and the evidence explained in ONE, it is my opinion that a POSITA would have found it obvious to combine the method and apparatus for testing a mobile communications system of Rimoni with the emulator of ONE.

659. As disclosed in the '330 Patent itself and as disclosed in ONE, the ONE emulator "models the routers and intervening network by delaying packets arriving on one network interface before forwarding them to the other network. *ONE* also provides congestion loss according to its configuration. The delay a packet experiences is based on the packet size and the configuration

parameters given by the user. The following three components of packet delay are modeled." ONE at 2; *see also* '330 Patent at 2:2-9.

660. ONE explains that it is able to model "three components of packet delay," including "transmission delay," which is "the amount of time it takes a network node to transmit a packet onto a given channel;" "queuing delay," which "occurs when a packet arrives at a router which is already busy transmitting another packet;" and "propagation delay," which is "the time it takes a packet to travel from one node to another along a physical channel." ONE at 2-3. "The sum of the above component delays is the amount of time ONE holds a packet before forwarding it." ONE at 3.

661. Packet delay is configurable based on "two user configurable parameters:" linespeed and propagation. ONE at 3-4. Packets are queued for transmission based on the following two user-configurable settings: qsize, which is "the size for the given interface," and memunit, which is "the internal buffer size (memory allocation granularity) used to store packets in the queue." ONE at 3-4.

662. A POSITA would have understood that because ONE discloses providing congestion loss as well as setting delay with user-configurable parameters, ONE discloses emulating attributes of a packet-based wired communications network including at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication.[25]

['330, 1(e)] a controller communicatively linked to each of said plurality of wireless network nodes, said controller configured to control the wireless communication characteristics of each of said plurality of wireless network nodes to simulate, without

[25] To the extent that Mobility contends that Verizon infringes this limitation through its standards compliance testing, *see* '330 Infringement Contentions at 22, standards that pre-date the '330 Patent disclose this limitation for all of the reasons explained above in Section VIII.B. and in the Amended Invalidity Contentions, *see* Exs.C-12 and C-13, which I hereby incorporate by reference.

changing operating parameters of said at least one mobile node, different wireless communication conditions experienced by said at least one mobile node in actual operation.

663. Rimoni discloses "a controller communicatively linked to each of said plurality of wireless network nodes, said controller configured to control the wireless communication characteristics of each of said plurality of wireless network nodes to simulate, without changing operating parameters of said at least one mobile node, different wireless communication conditions experienced by said at least one mobile node in actual operation." The parties agreed that the term "wireless network nodes" means "an element of a network that sends and receives signals wirelessly." The Court construed the term "communicatively linked" to mean "capable of transmitting and receiving signals via an interface."

664. First, Rimoni discloses a controller communicatively linked to each of said plurality of wireless network nodes. For example, Rimoni discloses that "[s]ystem **20** further comprises a controller **24** which controls operations of simulator **28** and unit **30**, and which is preferably implemented as an industry-standard personal computer. Controller **24** is coupled to unit **30**, to system simulator **28**, and to a database **22** wherein are stored parameters, test messages, and test signals used by the controller in performing tests" on the mobile units under test. Rimoni at [0060]. Thus, Rimoni discloses a controller 24 communicatively linked to both the base station simulator 28 (which, in turn, is communicatively linked to the base transceiver stations 21, Rimoni at [0058]) and the channel simulation unit 30, which controls simulation of attenuation between the base transceiver stations and mobile units, for example. Rimoni at [0060], [0023]. This connection can be seen in Figure 1 below.

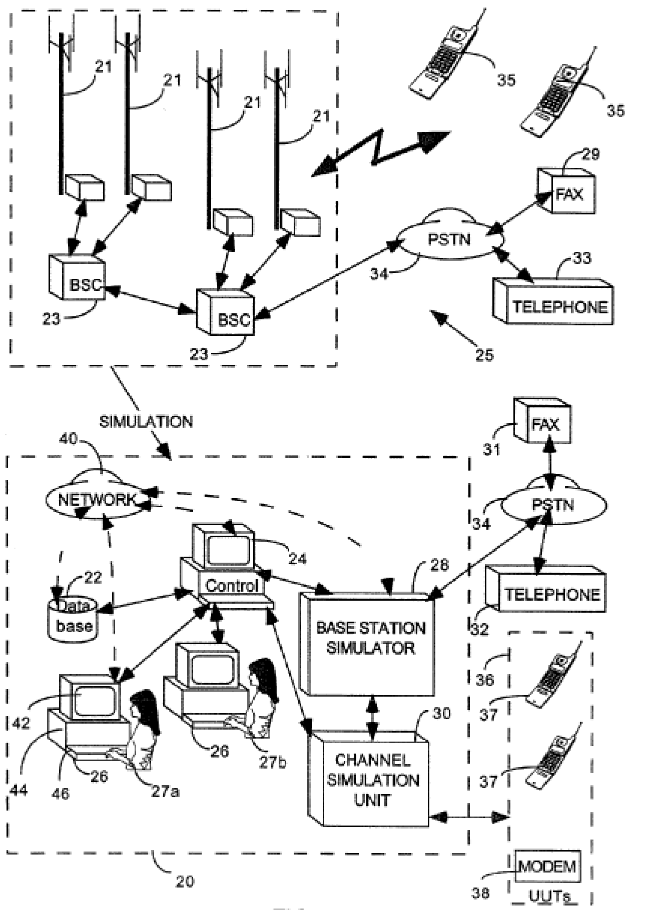


FIG. 1

665. Next, Rimoni discloses that the controller is configured to control the wireless communication characteristics of each of said plurality of wireless network nodes to simulate, without changing operating parameters of said at least one mobile node, different wireless communication conditions experienced by said at least one mobile node in actual operation. I understand that the Court construed the term "without changing operating parameters of said at least one mobile node" to be given its plain meaning. Claim Construction Order at 30. I understand that the parties agreed, and the Court did not disagree, during claim construction that the term "operating parameters" encompasses at least transmit power level. *Id.* I also understand that the specification of the '330 Patent explains numerous times that "attenuation provided by at least one

of the attenuators" and controlled by the controller "can be increased," "while simultaneously decreasing attenuation provided by another one of the attenuators," thus simulating movement away from and toward the wireless network nodes. '330 Patent at 2:63-66. The '330 Patent similarly explains that the simulation of movement of the wireless network nodes is performed via adjusting the wireless network nodes' transmit power level without the need to change the transmit power level (or physically move) the mobile node. '330 Patent at 2:25-28, 2:59-28, 3:10-21, 4:37-41, 5:17-25, 6:46-67.

666. I also understand that this limitation is discussed in the file history of the '330 Patent. In response to an anticipation rejection based on U.S. Patent No. 6,735,448 ("Krishnamurthy"), the applicant argued that Krishnamurthy did not anticipate this limitation because the mobile nodes in Krishnamurthy change their "own operating parameters, namely [their] own 'transmit power level.'" '330 File History, Response to Office Action dated Jan. 8, 2007, at 10. I also understand that the applicant pointed to the portion of the specification reciting that "[t]he mobile node 125 need not be a moveable or roaming component as the system 100 is configured to simulate motion of the mobile node 125 . . . despite the mobile node 125 being stationary in nature" to support the disclosure for this limitation. '330 File History, Response to Office Action dated Jan. 8, 2007, at 9 (citing paragraph [0023], lines 1-8 of Specification).

667. Rimoni similarly discloses a controller that adjusts the transmit power level of the wireless network nodes to simulate movement of the mobile nodes without adjusting the operating parameters of the mobile nodes. For example, Rimoni discloses that "[t]he simulation performed by the core simulator comprises allocation of channels, with appropriate channel parameters, for communication between the BTSs/BSCs and the mobiles, and provides a digital output. A second element of the simulator operates as an interface between the first element and the mobiles being

tested. The second element performs digital-to-digital and digital-to-RF conversions, so as to simulate RF communication between the one or more base stations and each of the mobiles under test via the allocated channels, and to incorporate "real-world" signal effects into the channels. Operating parameters of each of the elements of the network simulator can be configured and controlled independently by an operator." Rimoni at [0013]. Specifically, "the channel simulation circuitry includes one or more digital circuit boards (DCBs), wherein the one or more DCBs are adapted to simulate one or more of effects selected from a group consisting of noise, fading, attenuation, delay, Doppler shift, and reflection." Rimoni at [0023]; *see also id.* at [0042]. Within the channel simulation unit 30, the DCB 132 simulates these effects "based on a model of expected motion of a specific UUT 36 (such as traveling in an automobile) and expected environment considerations, such as reflections from buildings in a path between the UUT and the base station or stations with which it is in communication." Rimoni at [0096].

668. Because Rimoni discloses simulating effects such as noise, fading, attenuation delay, Doppler shift, and reflection, "based on a model of expected motion of a specific" unit under test, Rimoni discloses adjusting transmit power level or other operating parameters to simulate movement of the mobile units. A POSITA would have understood that this simulation would have been performed without changing the operating parameters of the mobile units, as Rimoni discloses that the mobile units are "under test." Generally, when performing tests on mobile units to determine their operating capabilities in a wireless communications network, the parameters of the mobile units are not changed so as to not introduce any additional variables into the testing environment.

5. <u>Analysis—Claim 3</u>

['330, 3(a)] The system of claim 1, wherein said wireless communication characteristics include a signal reception sensitivity.

669. Rimoni discloses "[t]he system of claim 1, wherein said wireless communication characteristics include a signal reception sensitivity."

670. As explained above regarding Element 1(e), Rimoni discloses, a DCB "adapted to simulate one or more of effects selected from a group consisting of noise, fading, attenuation, delay, Doppler shift, and reflection" "based on a model of expected motion of a specific UUT 36 (such as traveling in an automobile) and expected environment considerations, such as reflections from buildings in a path between the UUT and the base station or stations with which it is in communication." Rimoni at [0023], [0042], [0096]. Rimoni discloses, and a POSITA would have understood, that the DCBs adjust the transmit power level and/or signal reception sensitivity of the wireless network nodes, to simulate movement of the mobile nodes without adjusting the operating parameters of the mobile nodes. I hereby incorporate by reference my analysis above regarding Element 1(e).

6. Analysis—Claim 4

['330, 4(a)] The system of claim 1, wherein said wireless communication characteristic includes at least one of signal transmission strength, signal-to-noise ratio (SNR), and bit error rate (BER).

671. Rimoni discloses "[t]he system of claim 1, wherein said wireless communication characteristic includes at least one of signal transmission strength, signal-to-noise ratio (SNR), and bit error rate (BER)."

672. As explained above regarding Element 1(e), Rimoni discloses, a DCB "adapted to simulate one or more of effects selected from a group consisting of noise, fading, attenuation, delay, Doppler shift, and reflection" "based on a model of expected motion of a specific UUT 36 (such as traveling in an automobile) and expected environment considerations, such as reflections from buildings in a path between the UUT and the base station or stations with which it is in

communication." Rimoni at [0023], [0042], [0096]. Rimoni discloses, and a POSITA would have understood, that the DCBs adjust the transmit power level, including the signal transmission strength, signal-to-noise ratio (SNR), and/or bit error rate, of the wireless network nodes, to simulate movement of the mobile nodes without adjusting the operating parameters of the mobile nodes. I hereby incorporate by reference my analysis above regarding Element 1(e).

D. Cho Anticipates the Asserted Claims or Renders Them Obvious in View of NIST or ONE

1. Cho

673. Cho, Korean Patent Application Publication No. KR2001-0048715, was published on June 15, 2001. It therefore qualifies as prior art under 35 U.S.C. §§ 102(a) and (b) (pre-AIA). Cho was not cited or considered during the prosecution of the '330 Patent.

674. I understand that, to Defendant's knowledge, Plaintiff has not produced a copy of Cho in this litigation, although Cho, and a human translation thereof was relied upon in prior litigation. Although I have relied upon a machine-translated version of Cho in this Report, I reserve the right to rely upon a human-translated version of Cho, including the version relied upon in the earlier litigation.

675. The Abstract of Cho provides:

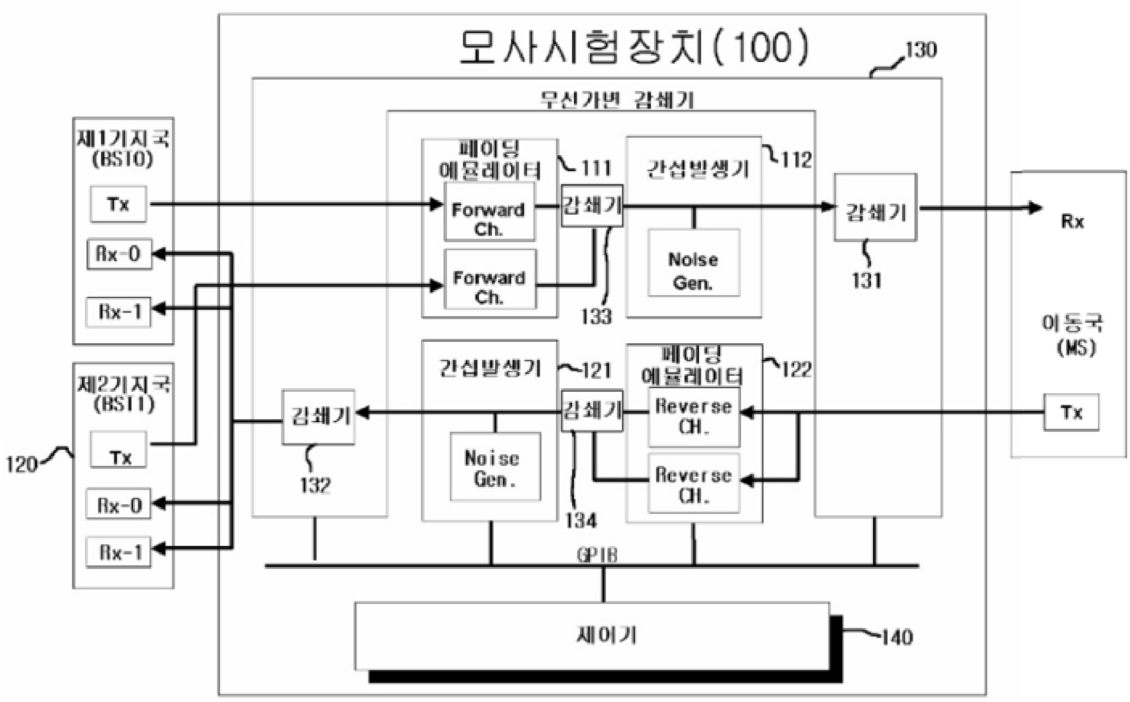
> The present invention relates to the method of emulating radio channels for the code division multiple access mobile communication system performance analysis which efficiently analyzes the performance of the mobile communication system of the code division multiple access base in the laboratory environment and apparatus thereof.
>
> The radio channel simulated testing device for such code division multiple access mobile communication system performance analysis comprises the forward fading emulator receiving the forward direction signal transmitted from the base station and is generated the fading signal according to the parametric value, the forward direction carrier to noise generator which is generated the noises signal in order

> to obtain the interference effect by the mobile station or the different base station, the forward direction radio variation attenuator which reflects the path loss effect to the mobile station after it adds the fading signal outputted in the forward fading emulator and the noises signal outputted in the forward direction carrier to noise generator and forms the forward channel, the reverse fading emulator receiving the backward signal transmitted from the mobile station and is generated the fading signal according to the parametric value, the reversible interference generator which is generated the noises signal in order to obtain the interference effect by the mobile station or the different base station, the fading signal outputted in the reverse fading emulator, and the backward direction radio variation attenuator which reflects the path loss effect to the base station after it adds the noises signal outputted in the reversible interference generator and forms the reverse channel.

Cho at Abstract.

676. Cho and the ’330 Patent similarly seek to address the problem of emulating movement of a mobile node in a wireless communication network. For example, Cho discloses an attenuator “which attenuates the signal so that it prevent that the electricity of being large of being connected to the program attenuator controlling the relative size of the per link attenuation formed between the base station and mobile station and emulates the path loss changed according to the position of the mobile station.” Cho at 5; *see also, e.g.*, ’330 Patent at 2:19-32, 2:59-3:3, 3:9-21, 3:27-38.

677. Cho discloses fading emulators 112, a carrier to noise generator 121, attenuators 130, 131, and 132, a controller 140, base stations BTS0 and BTS1 and a mobile station MS, as shown in Figure 1 below. Cho at 13, Fig. 1.



2. NIST Net

678. I hereby incorporate by reference my description of NIST Net given in Section XI.A.2.

3. ONE

679. I hereby incorporate by reference my description of ONE given in Section XI.A.3.

4. Analysis—Claim 1

[‘330, 1(a)] A system for emulating mobile network communications comprising:

680. Cho discloses that its invention “relates to the method of emulating radio channels for the code division multiple access mobile communication system performance analysis which efficiently analyzes the performance of the mobile communication system of the code division multiple access bse in the laboratory environment.” Cho at Abstract.

681. Cho explains the importance of testing mobile units prior to deployment in the network by explaining that "[a]s to the IMT-2000 system development of the code division multiple access (CDMA) base providing the multimedia service, it is the critical matter in which the performance test is certainly performed before the commercialization." Cho at 3. To test performance, "the radio channel environment which is similar to the real operation environment has to be built." Cho at 8. "Then, if since the field test is not passed through and the performance test is performed in the laboratory environment the performance is easily repetitively verified in the system development step and point or the disadvantage of being insufficient can be discovered at its early stage the performance improvement and improvement are facilitated." Cho at 3. For this reason, Cho explains that its goal is to provide the "testing method which is devised it satisfies the necessity and it cannot pass through the field test and can test the performance of the CDMA system in the laboratory environment and apparatus thereof of the prior art as described above." Cho at 4. Cho further explains that it discloses a "method of emulating radio channels for analyzing the soft handoff call channel performance between the base stations of 2 of the code division multiple access mobile communication system and one mobile station." Cho at 6.

682. That is, Cho emulates "the path loss, generated in the radio link the noises and interference, and the fading environment[, which] are played in the wired environment with test analysis." Cho at 4.

['330, 1(b)] a plurality of fixedly-located wireless network nodes configured to variably adjust wireless communication characteristics;

683. Cho discloses "a plurality of fixedly-located wireless network nodes configured to variably adjust wireless communication characteristics." The parties agreed that the term "fixedly-located" means "set at a particular location" and "wireless network nodes" means "an element of a network that sends and receives signals wirelessly." The Court construed the term "configured

to variably adjust wireless communication characteristics" as "configured such that the controller can cause the wireless network nodes to adjust wireless communication characteristics of the wireless network nodes."

684. For example, with reference to Figure 1 above, Cho discloses fading emulators 112, a carrier to noise generator 121, attenuators 130, 131, and 132, a controller 140, base stations BTS0 and BTS1 and a mobile station MS. Cho at 13; Fig. 1. Cho further discloses a "method of emulating radio channels for analyzing the normal call channel performance between the base station of the code division multiple access mobile communication system and the mobile station." Cho at 5.

685. A POSITA would have known that these base transceiver stations 21 would have been fixedly located such that they were set at a particular location. Cho discloses a "wireless channel" in which additive white Gaussian noise is applied "and the path loss which the base station according to the position of the mobile station and mobile station goes is freely controlled." Cho at 8. The channel that the mobile node operates on is a "radio channel" and "the various radio environment showing up as the noises, which is 3 kinds element determining the performance of the radio channel the path loss, and the combination of fading is easily controlled with configuration." Cho at 8. Cho discloses that "[t]his radio channel simulated testing device is connected to the transmission-reception port of one mobile station (MS) and two base station (BTS0, BTS1). When the performance is tested about the normal call, the radio channel is built between the first base station (BTS0) and mobile station (MS) or the second base station (BTS1) and mobile station (MS)." Cho at 9-10. Thus, the base stations send and receive signals wirelessly.

686. I have reviewed Mobility's infringement contentions, and I understand that Mobility may contend that a wired connection between the mobile nodes and the wireless network nodes infringes the claim 1 of the '330 patent. Under Mobility's infringement theory, it is my

opinion that Cho anticipates claim 1 in certain embodiments where the connection between the mobile unit and the base station may be wired.

687. Finally, the base stations of Cho are "configured to variably adjust wireless communication characteristics" such that they are "configured such that the controller can cause the wireless network nodes to adjust wireless communication characteristics of the wireless network nodes." As explained below regarding Element 1(e), Cho discloses a controller 140 communicatively linked to both the base stations, the fading emulators, and the attenuators, which control simulation of attenuation between the base stations and mobile station. Cho at 4-5, 8. The attenuators "attenuate[] the signal . . . controlling the relative size of the per link attenuation formed between the base station and mobile station and emulates the path loss changed according to the position of the mobile station" Cho at 5. Because the system models path loss and fading to model the position of the mobile station under test, Cho discloses that the wireless network nodes are "configured to variably adjust wireless communication characteristics." Cho at Abstract, 5.

['330, 1(c)] at least one mobile node configured to wirelessly communicate with selected ones of said plurality of wireless network nodes;

688. Cho discloses "at least one mobile node configured to wirelessly communicate with selected ones of said plurality of wireless network nodes." The parties agreed that the term "mobile node configured to wirelessly communicate" means "a device that sends and receives signals wirelessly" and "wireless network nodes" means "an element of a network that sends and receives signals wirelessly.

689. For example, with reference to Figure 1 above, Cho discloses fading emulators 112, a carrier to noise generator 121, attenuators 130, 131, and 132, a controller 140, base stations BTS0 and BTS1 and a mobile station MS. Cho at 13, Fig. 1.

690. Cho also discloses a "wireless channel" in which additive white Gaussian noise is applied "and the path loss which the base station according to the position of the mobile station and mobile station goes is freely controlled." Cho at 8. The channel that the mobile node operates on is a "radio channel" and "the various radio environment showing up as the noises, which is 3 kinds element determining the performance of the radio channel the path loss, and the combination of fading is easily controlled with configuration." Cho at 8. Cho discloses that "[t]his radio channel simulated testing device is connected to the transmission-reception port of one mobile station (MS) and two base station (BTS0, BTS1). When the performance is tested about the normal call, the radio channel is built between the first base station (BTS0) and mobile station (MS) or the second base station (BTS1) and mobile station (MS)." Cho at 9-10.

691. It is my opinion that Cho satisfies the limitation of the mobile units communicating wirelessly with the wireless network nodes, as described above. To the extent that Mobility argues that Cho does not disclose this limitation, it is my opinion that it would have been obvious to a person of ordinary skill in the art to adapt Cho to use a wireless connection.

692. I have reviewed Mobility's infringement contentions, and I understand that Mobility may contend that a wired connection between the mobile nodes and the wireless network nodes infringes claim 1 of the '330 Patent. For the reasons described above, it is my opinion that Cho anticipates and/or renders obvious claim 1 under Mobility's infringement theory as well.

['330, 1(d)] a network emulator communicatively linked to each of said plurality of wireless network nodes, said network emulator configured to emulate attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network, the emulated attributes comprising at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication; and

693. Cho discloses "a network emulator communicatively linked to each of said plurality of wireless network nodes, said network emulator configured to emulate attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network, the emulated attributes comprising at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication." The parties agreed that the term "wireless network nodes" means "an element of a network that sends and receives signals wirelessly" and the term "a packet-based wired communications network" means "a communications network in which packets of data are transmitted through wires or cables." The Court construed the term "communicatively linked" to mean "capable of transmitting and receiving signals via an interface."

694. First, it is my opinion that Cho discloses a network emulator that is configured to emulate attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network, the emulated attributes comprising at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication. For example, Cho discloses a carrier to noise generator 121 which "is generated the noises signal in order to obtain the interference effect by the mobile station or the different base station". Cho at Abstract, 13, Figure 1. The carrier to noise generator "test[s] the influence of the interference according to the traffic change within the monitoring cell or the same cell the noises is outputted to the wireless channel to the arbitrary absolute quantity or while the signal-noise ratio is regularly maintained in order to replace the electric power control function in the functional test including the power control in the code division access mobile communication

system the noises changed on a real time basis is outputted." Cho at 5. Because Cho discloses that it simulates a CDMA network, a POSITA would have known that it simulates a packet-based wired communications network. Cho at 3.

695. Next, Cho discloses that this network emulator is communicatively linked to each of said plurality of wireless network nodes. For example, Cho discloses that the "interference signal [s] independently generated through the carrier to noise generator (430) and interference intermediator (I REP2) is added with the fading signal passing through the attenuator (P ATT6)." Cho at 11. The signal from "the first base station (BTS1) is received and the channel outputs the fading signal to the method for being the same in the second fading emulator (FE 2-2) of the fading emulator part (410) and it is electric power diminished in the program attenuator (P ATT6)." Cho at 11. Thus, because the signal from the first base station passes through the program attenuator, to which the carrier to noise generator adds interference, the network emulator is communicatively linked to each of said plurality of wireless network nodes.

696. A POSITA would have known that emulating calls and a traffic environment, including "test[ing] the influence of the interference according to the traffic change within the monitoring cell," are attributes of a packet-based wired communications network for simulating network conditions experienced by said at least one mobile node in communicating with other nodes through the wired communications network. Further, a POSITA would have known that this emulation comprises at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication. A POSITA would have known, and it is my opinion, that emulating calls and a traffic environment, including "test[ing] the influence of the interference according to the traffic change within the monitoring cell," would comprise emulation of at least one of tunable packet-delay distribution, network congestion, bandwidth

limitation, and packet re-ordering and duplication. For example, a traffic environment necessarily involves emulation of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication simply by the very nature of emulating traffic. If multiple packets are being passed across the network as traffic, there will necessarily be a limitation on bandwidth, for example.

697. To the extent that Mobility contends that Cho does not disclose any portion of this limitation, it would have been obvious to a person of ordinary skill in the art at the time of the alleged invention to adapt the disclosures in Cho to include this limitation. Moreover, it would have been obvious to a person of ordinary skill in the art to combine the teachings of Cho with the teachings of NIST Net, for the reasons explained more fully below.

698. A POSITA would have been motivated to modify Cho to include the teachings and emulator of NIST Net because both of these references relate to systems for emulating mobile communications networks. Both Cho and NIST Net disclose known and interchangeable uses of emulator equipment, and a POSITA would have understood that combining a known prior art emulator, disclosed in NIST Net, with the simulation system of Cho would yield predictable and beneficial results.

699. Similarly, the ’330 Patent itself discusses the NIST Net emulator and provides it as an example of an optimal emulator for satisfying limitation **[‘330, 1(d)]**.’330 Patent at 5:60-6:2 (“For example, the emulator 110 can be implemented using a computer system executing the National Institute of Standards and Technology (NIST) emulator.”).

700. A POSITA would have understood that Cho and NIST Net would have been easily combinable. For example, NIST Net explains that it allows “*external* hooks into its module as well. External statistics generation code may supply values for NIST Net's generation of network effects.

. . . Alternatively, *external handlers* may work in concert with NIST Net or take over packet processing entirely." NIST Net at 115-116. Thus, a POSITA would have understood that it would have been easy to adapt the emulator of NIST Net to work in the system of Cho.

701. Moreover, NIST Net explains that it was easily and widely accessible as "[t]housands of people throughout the world ha[d] successfully installed and used the emulator for a wide variety of projects, even those with no prior experience with Linux. It has proven particularly useful in academic settings for class laboratories and student research projects." NIST Net at 112. In particular, NIST Net explains that in 2003, "[s]ince its initial release, NIST Net ha[d] been obtained by nearly twenty thousand people around the world, and has been used for a wide variety of testing purposes, including for voice over IP, mobile network emulation, adaptive video transmissions, satellite and underseas radio link emulation, and interactive network gaming." NIST Net at 125. Further, NIST Net explains that its code, documentation, and calibration results "are all public domain and are available through its web site." NIST Net at 125.

702. Because the NIST Net emulator was a well-known, easily-accessible, and easily-adaptable emulator at the time, as evidenced at least by the '330 Patent itself and the evidence explained in NIST Net, it is my opinion that a POSITA would have found it obvious to combine the method and apparatus for testing a mobile communications system of Cho with the emulator of NIST Net.

703. As disclosed in the '330 Patent itself and as disclosed in NIST Net, the NIST Net emulator is "a tool to facilitate testing and experimentation with network code through emulation. NIST Net enables experimenters to model and effect arbitrary performance dynamics (packet delay, jitter, bandwidth limitations, congestion, packet loss and duplication) on live IP packets

passing through a commodity Linux-based PC router." NIST Net at Abstract; *see also* '330 Patent at 5:60-6:2.

704. NIST Net similarly explains that "it provides the ability to emulate common network effects such as packet loss, duplication or delay; router congestion; and bandwidth limitations. It is designed to offer sufficient capabilities and performance to reproduce a wide range of network behaviors (forwarding rates of up to 1 Gbps, satellite-like delays or longer, asymmetric characteristics), while requiring only commodity PC hardware and operating systems." NIST Net at 111.

705. NIST Net explains that "[a] useful way to think of NIST Net is as a "network-in-a-box" (Figure 1) — a specialized router which emulates (statistically) the behavior of an entire network in a single hop. NIST Net selectively applies network effects (such as delay, loss, jitter) to traffic passing through it, based on user-supplied settings." NIST Net at 112. Specifically, the "set of network effects NIST Net can impose includes: packet delay, both fixed and variable (jitter); packet reordering; packet loss, both random and congestion-dependent; packet duplication; and bandwidth limitations." NIST Net at 112. NIST Net goes on to explain in detail how its packet delay, packet loss, packet duplication, packet reordering, congestion, and bandwidth limitations are calculated. NIST Net at 113-114, 118-119, 123-124.

706. The NIST Net graphical user interface showing the ability to adjust these various parameters is shown at Figure 3 below.

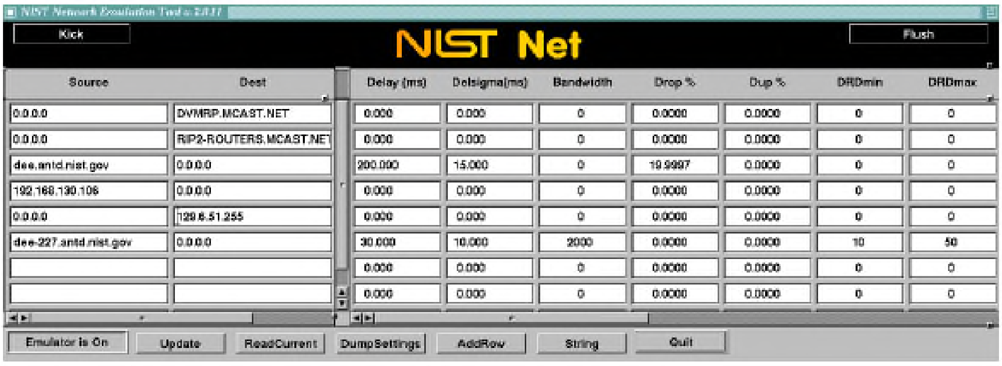


Figure 3: NIST Net graphical user interface

707. Thus, NIST Net discloses emulating attributes of a packet-based wired communications network including at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication.

708. To the extent that Mobility contends that Cho does not disclose any portion of this limitation, it would have been obvious to a person of ordinary skill in the art at the time of the alleged invention to adapt the disclosures in Cho to include this limitation. Moreover, it would have been obvious to a person of ordinary skill in the art to combine the teachings of Cho with the teachings of ONE, for the reasons explained more fully below.

709. A POSITA would have been motivated to modify Cho to include the teachings and emulator of ONE because both of these references relate to systems for emulating mobile communications networks. Both Cho and ONE disclose known and interchangeable uses of an emulator equipment, and a POSITA would have understood that combining a known prior art emulator, disclosed in ONE, with the simulation system of Cho would yield predictable and beneficial results. A POSITA would have understood that Cho and ONE would have been easily combinable. For example, ONE explains that it provides its emulated environment "to a wide

variety of hardware and software systems." ONE at 6. Thus, a POSITA would have understood that it would have been easy to adapt the emulator of ONE to work in the system of Cho.

710. Similarly, the '330 Patent itself discusses the ONE emulator and provides that it can "emulate transmission, queuing, and propagation delay between two computers interconnected by a router." '330 Patent at 2:2-9.

711. Because the ONE emulator was a well-known, easily-accessible, and easily-adaptable emulator at the time, as evidenced at least by the '330 Patent itself and the evidence explained in ONE, it is my opinion that a POSITA would have found it obvious to combine the method and apparatus for testing a mobile communications system of Cho with the emulator of ONE.

712. As disclosed in the '330 Patent itself and as disclosed in ONE, the ONE emulator "models the routers and intervening network by delaying packets arriving on one network interface before forwarding them to the other network. *ONE* also provides congestion loss according to its configuration. The delay a packet experiences is based on the packet size and the configuration parameters given by the user. The following three components of packet delay are modeled." ONE at 2; *see also* '330 Patent at 2:2-9.

713. ONE explains that it is able to model "three components of packet delay," including "transmission delay," which is "the amount of time it takes a network node to transmit a packet onto a given channel;" "queuing delay," which "occurs when a packet arrives at a router which is already busy transmitting another packet;" and "propagation delay," which is "the time it takes a packet to travel from one node to another along a physical channel." ONE at 2-3. "The sum of the above component delays is the amount of time ONE holds a packet before forwarding it." ONE at 3.

714. Packet delay is configurable based on "two user configurable parameters:" linespeed and propagation. ONE at 3-4. Packets are queued for transmission based on the following two user-configurable settings: qsize, which is "the size for the given interface," and memunit, which is "the internal buffer size (memory allocation granularity) used to store packets in the queue." ONE at 3-4.

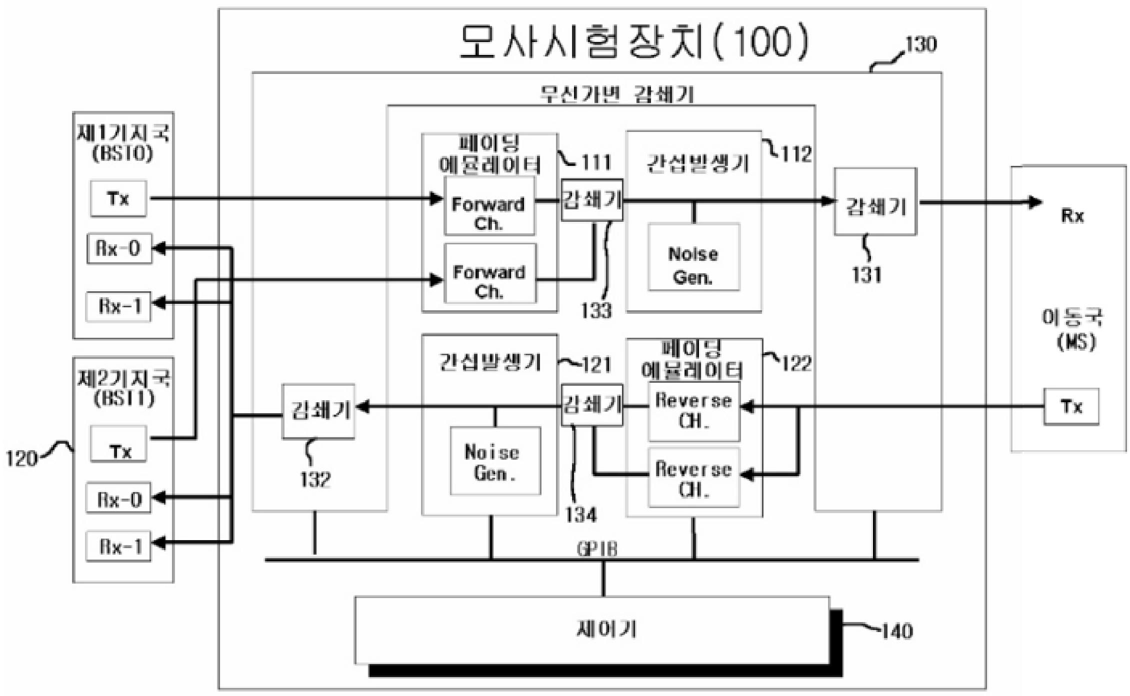
715. A POSITA would have understood that because ONE discloses providing congestion loss as well as setting delay with user-configurable parameters, ONE discloses emulating attributes of a packet-based wired communications network including at least one of tunable packet-delay distribution, network congestion, bandwidth limitation, and packet re-ordering and duplication.[26]

['330, 1(e)] a controller communicatively linked to each of said plurality of wireless network nodes, said controller configured to control the wireless communication characteristics of each of said plurality of wireless network nodes to simulate, without changing operating parameters of said at least one mobile node, different wireless communication conditions experienced by said at least one mobile node in actual operation.

716. Cho discloses "a controller communicatively linked to each of said plurality of wireless network nodes, said controller configured to control the wireless communication characteristics of each of said plurality of wireless network nodes to simulate, without changing operating parameters of said at least one mobile node, different wireless communication conditions experienced by said at least one mobile node in actual operation." The parties agreed that the term "wireless network nodes" means "an element of a network that sends and receives signals wirelessly." The Court construed the term "communicatively linked" to mean "capable of transmitting and receiving signals via an interface."

[26] To the extent that Mobility contends that Verizon infringes this limitation through its standards compliance testing, *see* '330 Infringement Contentions at 22, standards that pre-date the '330 Patent disclose this limitation for all of the reasons explained above in Section VIII.B. and in the Amended Invalidity Contentions, *see* Exs.C-12 and C-13, which I hereby incorporate by reference.

717. First, Cho discloses a controller communicatively linked to each of said plurality of wireless network nodes. Cho discloses a controller 140 communicatively linked to the base stations BTS0 and BTS1, the fading emulators 111 and 122, and the attenuators 130, 131, and 132, which control simulation of attenuation between the base stations and mobile station. Cho at 4-5, 8. For example, Cho discloses a "control unit which is better further includes the keypad, and the controller. As to the keypad, it controls the attenuation of the program attenuator and the radio variation attenuator inputs the attenuation of the fixed attenuator." Cho at 5. Thus, Cho discloses a controller 140 communicatively linked to the base stations, the fading emulators, and the attenuators, which control simulation of attenuation between the base stations and mobile station. Cho at 4-5, 8. This connection can be seen in Figure 1 below.



718. Next, Cho discloses that the controller is configured to control the wireless communication characteristics of each of said plurality of wireless network nodes to simulate,

without changing operating parameters of said at least one mobile node, different wireless communication conditions experienced by said at least one mobile node in actual operation. I understand that the Court construed the term "without changing operating parameters of said at least one mobile node" to be given its plain meaning. Dkt. 74 at 30. I understand that the parties agreed, and the Court did not disagree, during claim construction that the term "operating parameters" encompasses at least transmit power level. Dkt. 74 at 30. I also understand that the specification of the '330 patent explains numerous times that "attenuation provided by at least one of the attenuators" and controlled by the controller "can be increased," "while simultaneously decreasing attenuation provided by another one of the attenuators," thus simulating movement away from and toward the wireless network nodes. '330 patent at 2:63-66. The '330 patent similarly explains that the simulation of movement of the wireless network nodes is performed via adjusting the wireless network nodes' transmit power level without the need to change the transmit power level (or physically move) the mobile node. '330 Patent at 2:25-28, 2:59-28, 3:10-21, 4:37-41, 5:17-25, 6:46-67.

719. I also understand that this limitation is discussed in the file history of the '330 Patent. In response to an anticipation rejection based on U.S. Patent No. 6,735,448 ("Krishnamurthy"), the applicant argued that Krishnamurthy did not anticipate this limitation because the mobile nodes in Krishnamurthy change their "own operating parameters, namely [their] own 'transmit power level.'" '330 File History, Response to Office Action dated Jan. 8, 2007, at 10. I also understand that the applicant pointed to the portion of the specification reciting that "[t]he mobile node 125 need not be a moveable or roaming component as the system 100 is configured to simulate motion of the mobile node 125 . . . despite the mobile node 125 being

stationary in nature" to support the disclosure for this limitation. '330 File History, Response to Office Action dated Jan. 8, 2007, at 9 (citing paragraph [0023], lines 1-8 of Specification).

720. Cho similarly discloses a controller that adjusts the transmit power level of the wireless network nodes to simulate movement of the mobile nodes without adjusting the operating parameters of the mobile nodes. For example, Cho explains that "[t]he typical phenomenon that the signal passing can undergo the radio channel is the path loss, and fading and noises. While the path loss refers to that the signal strength reduces by the process where the signal departing from the transmitter reaches even the receiver among air with the collision with the particles this path loss is determined according to the distance between the receiver and the transmitter. While the attenuation respectively different through the multi-path between the receiver and the transmitter and the signals undergoing the delay are merged in the receiver fading refers to the phenomenon that atypically rapidly changes within the time when the signal size (Amplitude) and phase are short. Fading is affected of the serving frequency, the transition speed of the mobile terminal etc." Cho at 3-4. The invention of Cho is, therefore, to test the mobile station under the conditions of "path loss, generated in the radio link the noises and interference, and the fading environment are played in the wired environment with test analysis." Cho at 4. "[T]he program attenuator controlling the relative size of the per link attenuation formed between the base station and mobile station and emulates the path loss changed according to the position of the mobile station and exceeding the input range in the interlock test with the dissimilar equipment including the measuring instrument while being connected to the program attenuator is applied." Cho at 5; *see also* Cho at 9, 11.

721. Because Cho discloses simulating effects such as path loss and fading, based on the positions of the mobile station, Cho discloses adjusting transmit power level or other operating

parameters to simulate movement of the mobile units. A POSITA would have understood that this simulation would have been performed without changing the operating parameters of the mobile units, as Cho discloses that the mobile units are under test. Generally, when performing tests on mobile units to determine their operating capabilities in a wireless communications network, the parameters of the mobile units are not changed so as to not introduce any additional variables into the testing environment.

5. Analysis—Claim 3

[‘330, 3(a)] The system of claim 1, wherein said wireless communication characteristics include a signal reception sensitivity.

722. Cho discloses “[t]he system of claim 1, wherein said wireless communication characteristics include a signal reception sensitivity.”

723. As explained above regarding Element 1(e), because Cho discloses simulating effects such as path loss and fading, based on the positions of the mobile station, Cho discloses adjusting transmit power level or other operating parameters to simulate movement of the mobile units. Cho at 3-4. Cho discloses, and a POSITA would have understood, that the attenuators adjust the transmit power level and/or signal reception sensitivity of the wireless network nodes, to simulate movement of the mobile nodes without adjusting the operating parameters of the mobile nodes. I hereby incorporate by reference my analysis above regarding Element 1(e).

6. Analysis—Claim 4

[‘330, 4(a)] The system of claim 1, wherein said wireless communication characteristic includes at least one of signal transmission strength, signal-to-noise ratio (SNR), and bit error rate (BER).

724. Cho discloses "[t]he system of claim 1, wherein said wireless communication characteristic includes at least one of signal transmission strength, signal-to-noise ratio (SNR), and bit error rate (BER)."

725. As explained above regarding Element 1(e), because Cho discloses simulating effects such as path loss and fading, based on the positions of the mobile station, Cho discloses adjusting transmit power level or other operating parameters to simulate movement of the mobile units. Cho at 3-4. Cho discloses, and a POSITA would have understood, that the attenuators adjust the transmit power level, including the signal transmission strength, signal-to-noise ratio (SNR), and/or bit error rate, of the wireless network nodes, to simulate movement of the mobile nodes without adjusting the operating parameters of the mobile nodes. I hereby incorporate by reference my analysis above regarding Element 1(e).

XII. INVALIDITY OPINIONS BASED ON § 112

A. "wireless communication conditions" ('330 Patent, Claims 1, 3, 4)

726. The '330 Patent does not describe to a person of ordinary skill in the art how to make and use a "controller configured to control the wireless communication characteristics of each of said plurality of wireless network nodes to simulate . . . different *wireless communication conditions* experienced by said at least one mobile node in actual operation."

727. Although the specification and the claims of the '330 Patent explain that "wireless communication *characteristics*" may include, for example, signal reception sensitivity, signal transmission strength, signal-to-noise ratio (SNR), and bit error rate, '330 Patent at Claims 3, 4, 2:40-42, the specification does not include any description of what may comprise the "wireless communication *conditions* experienced by said at least one mobile node in actual operation." Indeed, the term "wireless communication conditions" is *only* used within the claims. A person of ordinary skill in the art would have known that there are many wireless communication conditions

that a mobile node may experience depending on the type of network in which it is operating, the various network equipment and parameters, and the air environment, for example. Without any guidance in the specification as to the type of conditions to be simulated, a person of ordinary skill in the art would not have known that the patentee was in possession of the invention and/or how to make or carry out the claimed invention without undue experimentation.

728. Accordingly, it is my opinion that this element fails to meet the written description and enablement requirements of 35 U.S.C. § 112.

XIII. SECONDARY CONSIDERATIONS OF NON-OBVIOUSNESS

729. I have been informed that certain secondary considerations may be examined to determine whether a certain invention would have been obvious to one of ordinary skill in the art. Below, I address the factual basis upon which, in my opinion, these secondary considerations likewise lead to a conclusion that the asserted claims would have been obvious to a POSITA. I also address below Plaintiff's assertion that the claimed inventions of the asserted claims provide performance benefits for an LTE network.

730. I am informed that in responses to Interrogatory Nos. 11 and 14 on this issue, Plaintiff has stated:

> [T]he inventions in question have: been incorporated into the LTE wireless communications standards, adopted by mobile network operators, like Verizon, largely replaced Verizon's legacy data and voice network, experienced substantial commercial success, exceeded expectations (e.g., Verizon's voice-over LTE), and enabled Verizon to move most of its voice traffic to its LTE network. *See, e.g.*, https://www.cnet.com/news/verizon-readies-lauch-of-nationwide-voice-over-lte-service/ ; *see also* Response to Interrogatory No. 14, incorporated here by reference. VoIP was being used in the early 2000s but was not implemented in cellular networks until much later because of a number of factors, including handover delay and network delay. The inventions of the asserted claims helped solve both of those problems in a manner that provided substantial gains in performance. See also the expert report produced in this case.

Plaintiff's Responses and Objections to Plaintiff's [*sic*] First Set of Interrogatories to Defendant [*sic*] at 28 (June 10, 2019).

> [T]he claimed subject matter provides advantages and benefits in the performance of Verizon's LTE network. Plaintiff has requested Verizon's internal assessments and evaluations of the improvements delivered by Verizon's adoption of the claimed subject matter. Such information is not publicly available. Generally speaking, LTE handoff procedures according to the claimed subject matter improve network performance by reducing the number of dropped data packets, decreasing the number of lost data packets, decreasing latency, by reducing the number of unsuccessful handovers, and by decreasing the amount of time necessary for such handovers. Further, improvement in VoLTE and VoLTE performance is noticeable by subscribers and thus valuable to Verizon, which advertises and markets the performance of the Verizon LTE network.
>
> In addition, just some of the additional benefits the Patents in suit offer are:
>
> - Efficient testing of new phones, instead of testing a new firmware or new phone models for weeks, it can be tested in hours with reproducible effects.
> - Full elimination of manual drive testing. Testing could take 8-12 weeks of very inaccurate testing.
> - LTE handover requires a hard-handover, hence CBRS LTE, LTE-licensed, and LTE-private, require a technology that creates a handover at all layers, physical layer and IP-layer interfaces in one step.
> - The '417 Patent enables that scenario, making it now possible to shut down a GSM or CDMA network, freeing bands for others, and doing voice and multimedia simultaneously in the same packet-based network, phasing out all circuit switched equipment.
> - This reduces cost of ownership, cost of operations, making the network more efficient, and enables SON (Self-Organizing Networks) and other more advanced software technologies to interact with Heterogeneous Nodes and technologies more efficiently.

Plaintiff's Responses and Objections to Plaintiff's [*sic*] First Set of Interrogatories to Defendant [*sic*] at 31-32 (June 10, 2019).

731. To the extent that Plaintiff later identifies any other alleged evidence of alleged secondary considerations of non-obviousness, I reserve the right to supplement my opinions.

732. **Commercial success.** Plaintiff has alleged that the purported invention enjoyed commercial success as explained above with respect to Plaintiff's response to Verizon's Interrogatory Nos. 11 and 14. This alleged evidence of commercial success does not change my opinions regarding obviousness of the Asserted Patents.

733. **'417 Patent.** In my opinion, the commercial success of the accused LTE network and the improvement in performance are not due to the alleged invention of the Asserted Claims of the '417 Patent. There is no so-called nexus between the commercial success and the alleged invention.

734. As described in more detail above in the invalidity analysis of the '417 Patent for the 3G UMTS standard's hard handover and SRNS relocation handover procedures, the prior art 3G UMTS handover procedures were substantially similar to the accused LTE handover procedures.

735. In the 3G handover procedures, entities other than the mobile node registered and allocated resources on the mobile node's behalf as it moved from one cell to the next. Plaintiff has not explained how any particular aspect of the Asserted Claims of the '417 Patent led to the improvements and commercial success described above.

736. In my opinion, the improvements in LTE network's over 3G UMTS networks were primarily due to the following changes, which are unrelated to the alleged invention:

- LTE simplified the radio architecture using only base stations, called eNodeBs, (eNBs) rather than base stations using both NodeBs (NB) and RNCs. In LTE, the eNB performs the functions of both UMTS NodeBs and UMTS RNCs – such as registering for and allocating the radio resources. The alleged invention did not propose this change in system architecture;

- LTE uses a different modulation technique than the 3G UMTS network, *i.e.*, OFDMA (orthogonal frequency-division multiple access) rather than WCDMA (Wideband Code Division Multiple Access), which significantly improves the speed and throughput of the network. The alleged invention did not propose this change in system architecture;

- LTE supports "flexible system bandwidth" using frequencies between 1.4 and 20MHz, while 3G UMTS uses fixed carrier bandwidth at 5MHz, which significantly improves the speed and throughput of the network. The alleged invention did not propose this change in system architecture;

- LTE is a packet-switched only system using the internet protocol on certain interfaces, while UMTS supported voice over the circuit-switched. The alleged invention did not propose this change in system architecture; and

- LTE uses different core domain nodes, like the MME, SGW, and PGW, rather than the SGSN and GGSN nodes in the 3G UMTS standard network. The alleged invention did not propose this change in system architecture. One motivation for this change was to separate the node which performed control related activities (control plane) from those performed processing of the calls (data packets) themselves (user plane) in order to save cost and provide higher scalability and flexibility of the network. For example, the SGSN was effectively split into the MME and the SGW of the evolved packet core (EPC).

737. To provide additional detail related to the performance benefits of LTE, unrelated to the handover process, the following table of requirements is provided:

Table 1.1: Summary of key performance requirement targets for LTE Release 8.

		Absolute requirement	Release 6 (for comparison)	Comments
Downlink	Peak transmission rate	> 100 Mbps	14.4 Mbps	LTE in 20 MHz FDD, 2 × 2 spatial multiplexing. Reference: HSDPA in 5 MHz FDD, single antenna transmission
	Peak spectral efficiency	> 5 bps/Hz	3 bps/Hz	
	Average cell spectral efficiency	> 1.6–2.1 bps/Hz/cell	0.53 bps/Hz/cell	LTE: 2 × 2 spatial multiplexing, Interference Rejection Combining (IRC) receiver [3]. Reference: HSDPA, Rake receiver [4], 2 receive antennas
	Cell edge spectral efficiency	> 0.04–0.06 bps/Hz/user	0.02 bps/Hz/user	As above, 10 users assumed per cell
	Broadcast spectral efficiency	> 1 bps/Hz	N/A	Dedicated carrier for broadcast mode
Uplink	Peak transmission rate	> 50 Mbps	11 Mbps	LTE in 20 MHz FDD, single antenna transmission. Reference: HSUPA in 5 MHz FDD, single antenna transmission
	Peak spectral efficiency	> 2.5 bps/Hz	2 bps/Hz	
	Average cell spectral efficiency	> 0.66–1.0 bps/Hz/cell	0.33 bps/Hz/cell	LTE: single antenna transmission, IRC receiver [3]. Reference: HSUPA, Rake receiver [4], 2 receive antennas
	Cell edge spectral efficiency	> 0.02–0.03 bps/Hz/user	0.01 bps/Hz/user	As above, 10 users assumed per cell
System	User plane latency (two way radio delay)	< 10 ms		LTE target approximately one fifth of Reference.
	Connection set-up latency	< 100 ms		Idle state → active state
	Operating bandwidth	1.4–20 MHz	5 MHz	(initial requirement started at 1.25 MHz)
	VoIP capacity	NGMN preferred target expressed in [2] is > 60 sessions/MHz/cell		

Sesia at 8 (Table 1.1).

738. Some of the technologies that were adopted for use with LTE, in order to meet the above requirements, include the following:

Table 9.20 LTE downlink efficiency benefit over HSPA Release 6 in macro cells

LTE benefit	Gain	Explanation
OFDM with frequency domain equalization	Up to +70% depending on the multi-path profile	HSDPA suffers from intra-cell interference for the Rake receiver. Rake receiver is assumed in Release 6. However, most HSDPA terminals have an equalizer that removes most intra-cell interference.
Frequency domain packet scheduling	+40%	Frequency domain scheduling is possible in OFDM system, but not in single carrier HSDPA. The dual carrier HSDPA can get part of the frequency domain scheduling gain.
MIMO	+15%	No MIMO defined in HSDPA Release 6. The gain is relative to single antenna base station transmission. HSDPA Release 7 includes MIMO.
Inter-cell interference rejection combining	+10%	The interference rejection combining works better in OFDM system with long symbols.
Total difference	$=3.0\times$	$1.7 \times 1.4 \times 1.15 \times 1.1$

Holma at 244 (Table 9.20).

739. Plaintiff has not explained the nexus or connection between the claimed invention of the ’417 Patent and the improvements/commercial success it points to in LTE networks.

740. To the extent Plaintiff and its experts (at some point in the future) allege that the claimed nexus is that the ghost-mobile node creates replica IP messages, I would disagree that creating replica IP messages leads to the benefits ascribed to invention in the LTE network.

741. More specifically, nothing about using IP messaging over the X2 interface is what allows for the improvements in the LTE network mentioned by Plaintiff. As explained above in the 3G UMTS invalidity analysis for the ’417 Patent, the Iur interface between RNCs in the 3G UMTS network already used IP messaging.

742. Similarly, in Release 5 of the 3G UMTS standard, the Iub Interface Protocol employed IP messaging. *See, e.g.*, 3GPP TS 25.430 v5.1.0 (UTRAN Iub interface) (6/2002) § 5.2 & Fig. 7:

5.2 Functional split over Iub

5.2.1 Management of Iub Transport Resources

The underlying transport resources (AAL2 and UDP/IP transport bearers) shall be set up and controlled by the RNC. Further information on these functions is provided in the transport layer specifications [3], [8], [10].

5.2.6.2 Handover Decision

To support mobility of the UE to UTRAN connection between cells, UTRAN uses measurement reports from the UE and detectors at the cells.

The RNC takes the decision to add or delete cells from the connection.

7 Iub Interface Protocol Structure

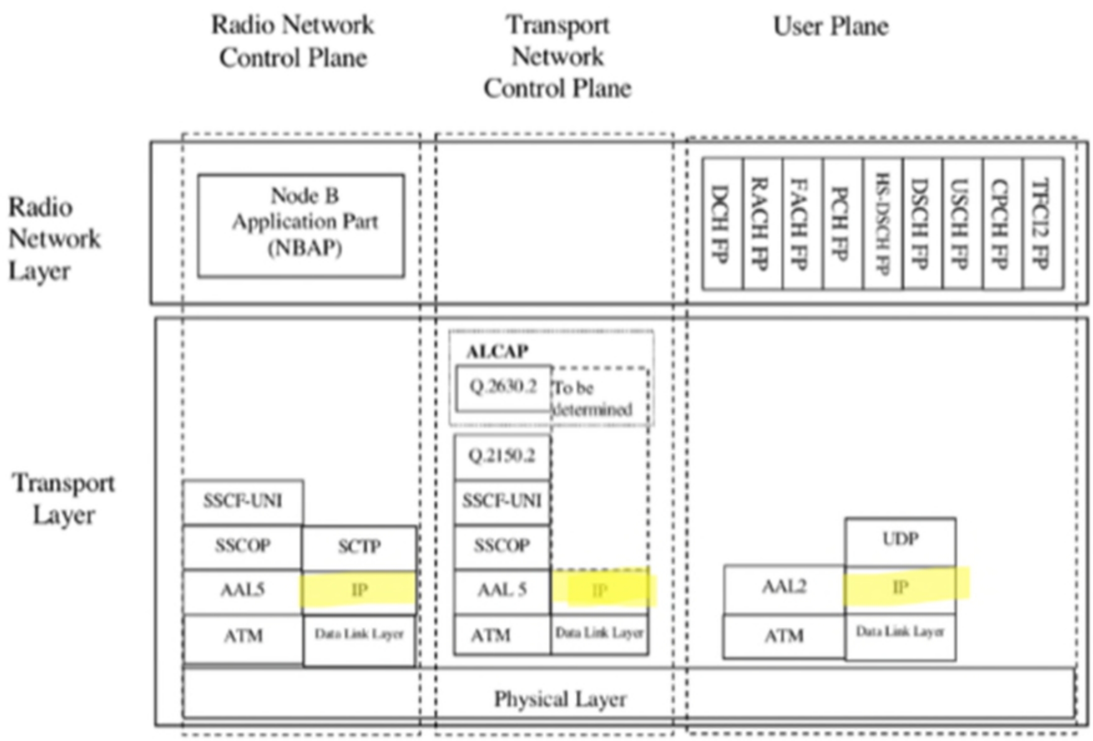


Figure 7: Iub Interface Protocol Structure.

See also 3GPP TR 25.933 Release 5 V5.1.0 (2002-06) (IP transport in UTRAN):

3GPP TR 25.933 version 5.1.0 Release 5 28 ETSI TR 125 933 V5.1.0 (2002-06)

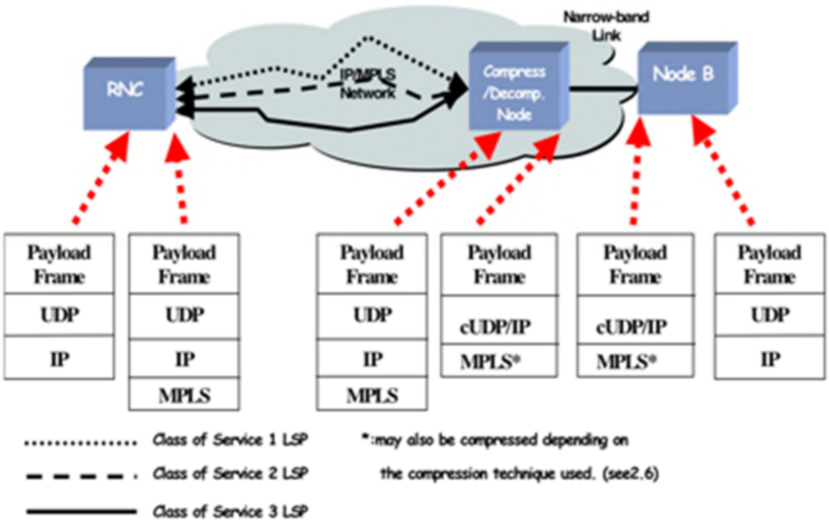


Figure 6-11: Protocol stacks at key nodes in the network for a MPLS-based transport solution

743. Therefore, the idea of using IP in the transport layer was not new in standardized cellular networks and is not what enabled VoLTE or other improvements in LTE networks. Instead, the changes in other aspects of the network mentioned above permitted a packet-switched system to be used for voice signals, rather than a circuit-switched system.

744. It is also worth noting that the control and user plane connections between the user and the eNodeB in the LTE network are not IP-based messages, and therefore there is no replication of any "IP message" that would otherwise be sent by a mobile node.

745. For example, the figures below depict the control and user planes protocol stacks used between the nodes in an LTE network, from which it can be seen that IP messages are not exchanged between the UE (mobile node) and the eNodeB (alleged ghost-mobile node):

2.3.2 Control Plane

The protocol stack for the control plane between the UE and MME is shown in Figure 2.6.

No IP at all on the control plane

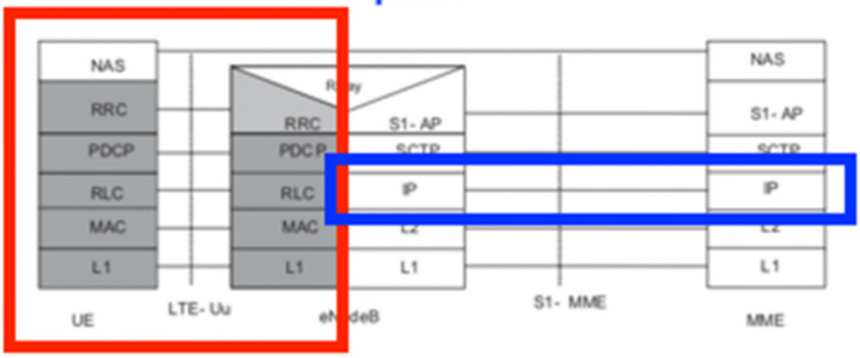


Figure 2.6: Control plane protocol stack. Reproduced by permission of © 3GPP.

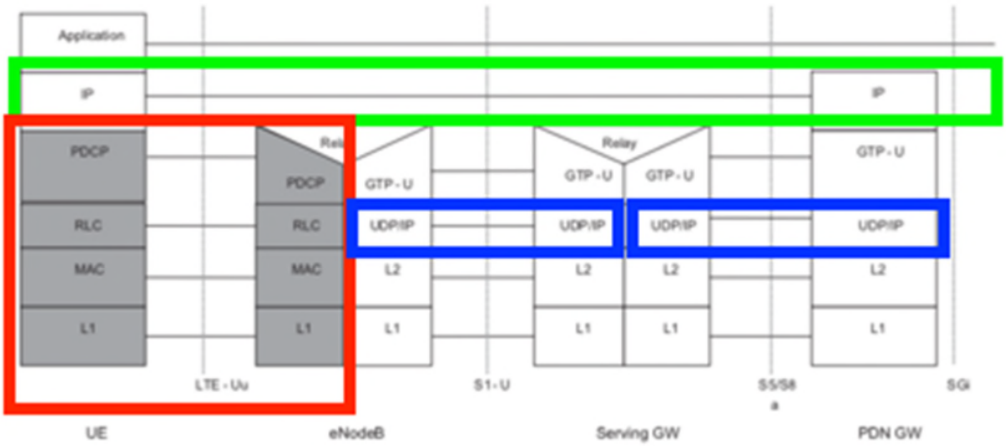


Figure 2.5: The E-UTRAN user plane protocol stack. Reproduced by permission of © 3GPP.

Sesia at 33 (Figs. 2.5-2.6).

746. To the extent Plaintiff and its experts (at some point in the future) allege that the nexus is that the ghost-mobile node can pre-register a mobile node and allocate resources based on a predicted physical location of the mobile node, I would disagree because the procedures that Plaintiff points to allege that this functionality exists in the LTE network is nearly identical to functionality that already exited in the 3G UMTS standard network.

747. **’330 Patent.** With respect to the ’330 Patent, Plaintiff has only alleged the following alleged benefits: “[S]ome of the additional benefits of the Patents in suit . . . are: Efficient testing of new phones, instead of testing a new firmware or new phone models for weeks, it can be tested in hours with reproducible effects;” and “[f]ull elimination of manual drive testing. Testing could take 8-12 weeks of very inaccurate testing.” Plaintiff’s Responses and Objections to Plaintiff’s [*sic*] First Set of Interrogatories to Defendant [*sic*] at 32 (June 10, 2019). This alleged evidence of benefits of the ’330 Patent does not change my opinions regarding obviousness of the Asserted Patents.

748. First, Plaintiff has provided no support that the ’330 Patent offers “[e]fficient testing of new phones, instead of testing a new firmware or new phone models for weeks, it can be tested in hours with reproducible effects.” Plaintiff has further provided no support that use of the ’330 Patent results in “[f]ull elimination of manual drive testing” which “could take 8-12 weeks of very inaccurate testing.” There is no evidence for me to meaningfully evaluate these allegations of benefits or commercial success, so they do not change my opinions regarding obviousness of the Asserted Patents.

749. In my opinion, the commercial success of the accused testing system are not due to the alleged invention of the Asserted Claims of the ’330 Patent. There is no so-called nexus between the commercial success and the alleged invention.

750. As described in more detail above in the background section and invalidity analysis of the ’330 Patent, the prior art testing procedures were substantially similar to the alleged invention of the ’330 Patent.

751. **Teaching away.** Plaintiff has not alleged (and has not cited any facts supporting an allegation) that the purported invention taught away from the technical direction followed by those

skilled in the art. Consequently, this secondary consideration does not change my opinions regarding obviousness of the Asserted Patents.

752. **Long-felt but unsatisfied need.** Plaintiff has not alleged (and has not cited any facts supporting an allegation) a long-felt but unsatisfied need for the invention while the needed implementing arts and elements had long been available. Consequently, this secondary consideration does not change my opinions regarding obviousness of the Asserted Patents.

753. **Unexpected results.** Plaintiff has not alleged (and has not cited any facts supporting an allegation) that the purported invention achieves results that are unexpected to those skilled in the art. Consequently, this secondary consideration does not change my opinions regarding obviousness of the Asserted Patents.

754. **Rapid replacement.** Plaintiff has not alleged (and has not cited any facts supporting an allegation) that the purported invention rapidly replaced the prior-art devices in the industry. Consequently, this secondary consideration does not change my opinions regarding obviousness of the Asserted Patents.

755. **Copying.** Plaintiff has not alleged (and has not cited any facts supporting an allegation) that there was prompt copying of the invention by competitors as distinguished from their independent development. Consequently, this secondary consideration does not change my opinions regarding obviousness of the Asserted Patents.

756. **Unsuccessful attempts.** Plaintiff has not alleged (and has not cited any facts supporting an allegation) that there were unsuccessful attempts by those skilled in the art to make the invention. Consequently, this secondary consideration does not change my opinions regarding obviousness of the Asserted Patents.

757. **Acquiescence by the industry.** Plaintiff has not alleged (and has not cited any facts supporting an allegation) that there was acquiescence by the industry to the patent's validity by honoring the patent through not infringing the patent. Consequently, this secondary consideration does not change my opinions regarding obviousness of the Asserted Patents.

758. **Skepticism or disbelief.** Plaintiff has not alleged (and has not cited any facts supporting an allegation) that there was skepticism or disbelief in or incredulity on the part of those skilled in the art that the patentee's approach worked. Consequently, this secondary consideration does not change my opinions regarding obviousness of the Asserted Patents.

759. **Recognition by peers.** Plaintiff has not alleged (and has not cited any facts supporting an allegation) that there was recognition by peers of the purported invention's advancement over the art by technically competent peers (*e.g.*, awards, articles, etc.). Consequently, this secondary consideration does not change my opinions regarding obviousness of the Asserted Patents.

XIV. OTHER COMMENTS

760. My opinions are subject to change based on additional opinions that Plaintiff's experts may present and information I may receive in the future or additional work I may perform. With this in mind, based on the analysis I have conducted and for the reasons set forth above, I have preliminarily reached the conclusions and opinions in this Report.

761. In connection with my anticipated testimony in this action, I may use as exhibits various documents produced in this case that refer or relate to the matters discussed in this Report. I have not yet selected the particular exhibits that might be used. In addition, I may create or assist in the creation of certain demonstrative evidence to assist me in testifying, and I reserve the right to do so to further support the positions in this Report.

762. At trial, and as discussed above, I may rely on visual aids and may rely on analogies concerning elements of the Asserted Patents, the Accused Products, the prior art referenced in this Report, or any related technologies.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed this 20th day of June, 2019, in Indialantic, FL.

James A. Proctor, Jr.